C6985-5-F

U.S.A.
OIL INDUSTRY OUTLOOK
1986 - 1990

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Preface

Oil Industry Outlook, Second Edition
by Robert J. Beck, Economics Editor of the Oil & Gas Journal

Author Biography

Robert J. Beck received a B.S. in Economics and an M.S. in International Economics at the University of Wisconsin in 1961 and 1965. After graduation, Beck spent a total of four years working first as Staff Economist and Statistician for Wisconsin Telephone Company, then as Economic Research Director for Mackay-Shields Economics, Inc. of New York. In 1969, Beck became a member of the Corporate Planning Department of the Oil Service Company of Iran (OSCO). During his 10 years of service with OSCO, Beck worked in both Ahwaz and Masjid-i-Sulaiman in Iran. In 1979, Beck left his position with OSCO and became the Economics Editor of the Oil & Gas Journal of Tulsa, Oklahoma.

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Publication Date

This special report was published in July, 1985. Published annually.

Publisher

Published by the PennWell Book Division of PennWell Publishing Company, publishers of the *Oil & Gas Journal, Offshore Magazine, Petroleo Internacional, Oil, Gas and Petrochem Equipment and Ocean Oil Weekly Report.*

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PennWell Publishing Company
1421 South Sheridan Road
P.O. Box 1260
Tulsa, Oklahoma 74101

ISSN 0741-3343

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Printed in the United States of America

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Introduction

THE OIL AND GAS industry, both worldwide and in the U.S., is undergoing a major transition. A transition that is taking much longer than most analysts anticipated. And it is a transition of major proportions and of great consequences to those involved in the industry. The industry is being reshaped, conforming to new economic and political realities. Survival is dependent upon being aware of the changes and adjusting without delay.

Prices of crude oil and products have been falling for over four years. It is uncertain whether this will help stimulate demand. In the recent past prices of crude oil moved upward well ahead of average production costs and had a major impact on demand. Prices were based more on "what the traffic would bear" than the cost of production.

The industry is faced with massive excess crude production capacity. And it is uncertain when this overhanging surplus will be eliminated and alleviate the downward pressure on prices. In the recent past control of a substantial portion of worldwide crude production and worldwide reserves was shifted to less predictable custodians—the OPEC countries. Although a substantial number of other producing countries have either increased their output or have already developed production capacity, the transfer of control from the international oil companies has increased uncertainty.

In addition, the industry is faced with massive excess refining capacity, unprecedented in the history of the industry. And OPEC has adopted a policy of expanding their refining capabilities, further compounding the problem, and adding to uncertainty.

Demand for petroleum products moved up marginally in 1984. But this followed an extended period of falling demand, also unprecedented in the history of the industry. Future demand for petroleum products and natural gas is a major uncertainty.

This is only a partial list of events that are presently reshaping the industry and that will have a profound impact on the future of the industry.

The entire foundation for making projections, forecasts and decisions is unstable. About the only thing that is certain is that the future industry will not look like the past industry.

But uncertainty is not new in the oil industry or elsewhere. Any philosopher will tell you, "the only thing certain in life is uncertainty." And anyone close to the oil industry will tell you that "the only thing certain about the oil industry is risk".

It is an industry of risk and uncertainty.

But even in the face of all this uncertainty forecasts have a value. Forecasts are a valuable, essential tool for decision making. The "bottom line" for the forecasting industry is a better decision. As bad as industry projections have been in the past it is essential that they continue to be developed. The more information obtained to assist operating and investment decisions and the clearer the understanding of potential future events that will effect the industry, the more likely that a decision will make a positive contribution to a company's performance. A decision is seldom, if ever, 100% right or wrong. The outcome is usually some gradation of right or wrong. Any information that can improve the decision and can increase the overall return on the company's investment is a valuable addition.

Forecasts and projections can be useful tools that help reduce risk. But in order to be a useful tool a forecast must be based on an understanding of recent events and their effect on the industry. It must be internally logical and consistent. And it must use tried and tested economic theory as a framework.

Any forecast must be founded on a set of assumptions and must reflect the actual workings of the industry and economic system.

What is essential is that the basic assumptions used and conclusions drawn are logical. And that they hold together based on an understanding of the industry. Recent events and trends must be analyzed and dissected and logical expectations determined.

Historical relationships should not be discarded without reliable proof of the change.

Political, noneconomic events can upset the best forecast. But if a forecast is to be an aid in decision making it must be based on known economic relationships rather than imagined future political events.

The industry is changing but the outcome is still determined by basic economic principles.

This outlook booklet has been developed to provide industry decision makers and analysts with a number of items. It is first an outlook for the worldwide and domestic oil and gas industry for the next 5 years. It is also a review of recent events that have had a major impact on the industry. And it is a guide to the factors to consider when preparing a forecast for decision making. It points out the factors that are essential and must be taken into consideration when making decisions for the future industry.

In addition, the booklet provides the essential oil and gas industry historical data for additional individual analysis. It enables the adoption of an alternative set of assumptions and the development of alternative outlooks. Although a decision must be based on one perception of the future, a set of alternative assumptions and forecasts often aids decision making.

It is essential that companies develop a strategy for adapting to the changes occurring in the industry and a strategy for operating under the new conditions in the industry. The strategy that worked in the 1970s, in terms of business practices, will not necessarily work in the 1980s, or in the 1990s.

This outlook booklet and future editions will be of assistance, clarifying recent events and trends and providing a logical and consistent outlook. The objective of being in any business is to maximize the return from the investment.

The future may be filled with uncertainty, but it is also filled with exciting opportunities. The only way to take advantage of opportunities is to make decisions and take risks. This booklet will help reduce risks and make the decisions more profitable.

Worldwide Outlook — Demand

Worldwide Outlook—Demand

UNDERSTANDING what is happening in the oil industry in the United States is dependent upon understanding the trends in the worldwide oil industry. A worthwhile domestic outlook requires substantial consideration be given to a likely outlook from a global perspective.

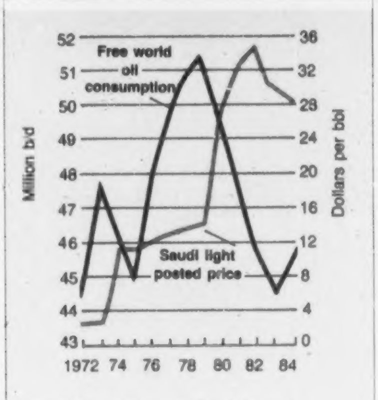
Oil products are consumed throughout the world in the industrial economies, in the developing countries of Latin America, Africa, and the Far East, and in the Communist countries. A cohesive comprehensive outlook must take petroleum product demand in all of these areas into consideration. It is demand for oil products to fuel economic activity that is the determining factor for the level of all activity in the oil industry.

Energy is one of the essential inputs for all economic output. But, the relationship between economic activity and energy consumption has been altered dramatically over the past decade. The rapid increase in the cost of oil, and energy in general, helped break the lock step relationship between economic growth and energy consumption.

The world economy being the essential determinant, the expected level of economic activity is the base for building a solid forecast. There is no aggregate measure of overall world economic activity. But there are some regional measures, particularly for the industrial countries. Aggregate economic activity is measured for the countries in the Organization for Economic Cooperation and Development (OECD). This is a group of 24 industrial countries.

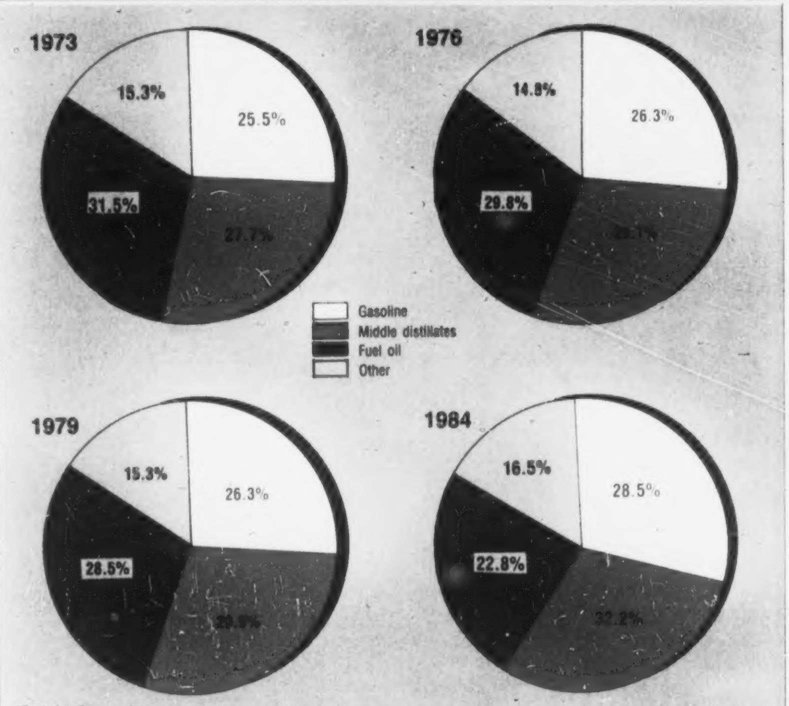
Over the period of 1972 to 1982 aggregate real economic growth for the total group of countries averaged 2.5% per year. The most recent economic recession hit a trough in most of the industrial countries during the fourth quarter of 1982. And an upturn in economic activity started slowly in 1983. Real economic growth for the OECD group was 2.6% in 1983. The rate of growth accelerated in 1984 and the OECD total economic activity increased 4.9%. The U.S. economy led the way in both years. Real GNP in the U.S. increased 3.7% in 1983 and 6.8% in 1984. Japan followed with an increase of 3.4% in 1983 and 5.8% in 1984. Canada was next with growth rates of 3.3% in 1983 and 4.7% in 1984. As a group the four major European industrial countries, Germany, France, United Kingdom and Italy had a growth rate of 1.3% in 1983 and 2.3% in 1984.

World oil consumption and price



Source: British Petroleum and Energy Information Administration

Worldwide* consumption of refined products by major products



*Excludes Communist areas

Source: British Petroleum

Worldwide petroleum product market share

	1973 %	1976 %	1979 %	1982 %	1983 %	1984 %
U.S. and CANADA						
Gasoline	37.6	38.6	37.3	41.5	42.1	41.8
Middle distillates	25.2	25.7	27.0	26.9	27.2	28.1
Fuel oil	18.4	18.0	17.1	12.9	11.2	10.5
Other	18.8	17.7	18.6	18.7	19.5	19.6
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
WESTERN EUROPE and JAPAN						
Gasoline	17.2	18.5	19.4	21.3	22.3	22.1
Middle distillates	29.4	30.7	31.9	33.7	34.8	35.2
Fuel oil	40.5	38.4	35.6	30.0	27.5	27.1
Other	12.9	12.4	13.1	15.0	15.4	15.6
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
REST OF WORLD*						
Gasoline	19.1	18.6	19.0	19.6	19.7	19.5
Middle distillates	29.0	32.7	32.1	33.4	33.4	33.5
Fuel oil	37.8	34.6	35.2	33.4	33.2	33.2
Other	14.1	14.1	13.7	13.6	13.7	13.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
TOTAL WORLD*						
Gasoline	25.5	26.3	26.3	28.0	28.7	28.5
Middle distillates	27.7	29.1	29.9	31.2	31.7	32.2
Fuel oil	31.5	29.8	28.5	24.8	23.2	22.8
Other	15.3	14.8	15.3	16.0	16.4	16.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

*Excludes communist areas

Source: British Petroleum

Preliminary estimates for 1985 indicate that the rates of economic growth have slowed for the total OECD. Economic growth for the total OECD is estimated at 3.25% in 1985. U.S. economic growth has slowed to an estimated 3.25%, Japan 5.25% and Canada 3.25%. The four European countries as a group are estimated at 2.25%.

The rate of aggregate economic growth is expected to slow even more in 1986. For the total OECD it is forecast at 2.25%. The U.S. is expected to slide to 2.75% in 1986. The worldwide effects of the huge budget deficits, debt, and growing protectionism are expected to be felt in 1987. It is expected that this will bring economic growth almost to a halt in 1987. However it is expected that ample adjustments will be made in the worldwide economy to stimulate growth again in the latter part of the forecast period 1988–1990. One of the keys to economic growth is the level of private investment that can be generated. And the keys to generating private investment in economic growth is controlling inflation and minimizing the burden of government debt. Long range expectations are for free world economic growth at the rate of 3% per year.

As stated earlier, the relationship betwen economic growth and energy has changed markedly. There is no measure of overall worldwide economic growth so a ratio cannot be determined. However, price induced conservation has reduced energy consumption throughout the industrial world. This has been more pronounced in recent years, following the 1978–79 oil price hike. In developing areas, conservation of energy has not been as evident as in industrial areas. In these developing areas industrialization is still the major economic policy objective and supersedes attempts at conservation.

The ratio of energy to gross economic output can be expected to continue to fall worldwide but particularly in the industrial areas. World primary energy consumption moved up steadily until it peaked in 1979 at 50.9 billion bbl of oil equivalent. During the ten year span 1969–1979, world energy consumption increased 51.6%, or at an average annual rate of about 4.2% per year. However, following the sharp increase in energy costs in the 1970's and early 1980's, a conservation effect was felt and energy consumption leveled off.

Total world energy consumption actually fell 1.2% between 1979 and 1982. As energy prices began to moderate consumption increased 1.2% in 1983. Lower oil prices and more vigorous economic growth helped boost it 3.7% in 1984, to a record high 52.8 billion bbl of oil equivalent.

For the non communist countries energy consumption is still below the 1979 peak. The 1984 consumption was 34.9 billion bbl of oil equivalent compared to 35.0 billion bbl in 1979. The conservation effect had the biggest impact on the industrial countries with energy intensive economies. Between 1979 and 1983, U.S. energy consumption fell 10.8%, Western Europe energy consumption fell 8.0% and Japanese energy consumption fell 7.8%. Most of these countries were highly dependent upon oil to fuel economic growth and the huge increase in oil prices provided substantial incentive for conservation.

With the upswing in overall economic activity energy consumption can be expected to increase over the forecast period. Conservation will continue to dampen demand but this should be offset by the effect of lower real prices and economic growth. Total primary energy consumption can be expected to increase 10.4% by 1990 to fuel growth in economic activity. This is a growth rate of only 2.0%

World primary energy consumption and market share

	1974	% of total	1976	% of total	1978	% of total	1979	% of total	1980	% of total	1982	% of total	1983	% of total	1984	% of total
	(Million barrels oil equivalent)															
Oil	20.233	46.3	21.217	46.0	22.595	46.0	22.908	45.0	22.001	43.5	20.707	41.2	20.534	40.3	20.850	39.5
Natural gas	8.076	18.5	8.364	18.1	8.867	18.0	9.366	18.4	9.574	18.9	9.653	19.2	9.716	19.1	10.335	19.6
Coal	12.396	28.4	13.097	28.4	13.658	27.8	14.483	28.5	14.708	29.0	15.006	29.8	15.400	30.3	15.976	30.3
Water power	2.555	5.8	2.659	5.8	2.951	6.0	3.023	5.9	3.080	6.1	3.307	6.6	3.482	6.8	3.558	6.7
Nuclear	459	1.0	780	1.7	1.096	2.2	1.121	2.2	1.242	2.5	1.594	3.2	1.762	3.5	2.069	3.9
Total*	**43.719**	**100.0**	**46.117**	**100.0**	**49.167**	**100.0**	**50.901**	**100.0**	**50.605**	**100.0**	**50.267**	**100.0**	**50.894**	**100.0**	**52.788**	**100.0**

*Excludes miscellaneous fuels not mentioned specifically

Source: British Petroleum

World oil consumption

Country Area	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	% change 84/73	% change 84/79
										1.000 b/d											
NORTH AMERICA																					
USA*	11.850	12.275	13.085	13.815	14.350	14.845	15.990	16.870	16.150	15.875	16.980	17.925	18.255	17.910	16.460	15.550	14.765	14.745	15.150	-10.2	-15.4
Canada	1.210	1.285	1.375	1.440	1.525	1.585	1.655	1.755	1.785	1.735	1.790	1.810	1.835	1.915	1.855	1.760	1.565	1.470	1.450	-17.4	-24.3
Total North America	**13.060**	**13.560**	**14.460**	**15.255**	**15.875**	**16.430**	**17.645**	**18.625**	**17.935**	**17.610**	**18.770**	**19.735**	**20.090**	**19.825**	**18.315**	**17.310**	**16.330**	**16.215**	**16.600**	**−10.9**	**−16.3**
Latin America	2.105	2.195	2.325	2.510	2.645	2.820	3.060	3.355	3.495	3.520	3.570	3.820	3.975	4.230	4.400	4.445	4.665	4.540	4.535	35.2	7.2
WESTERN EUROPE																					
Austria	120	130	150	160	185	205	215	235	210	215	230	225	240	250	245	225	210	205	200	-14.9	-20.0
Belgium & Luxembourg	350	390	440	500	560	570	620	635	560	535	560	565	585	560	540	500	475	435	425	-33.1	-24.1
Denmark	235	245	275	330	365	365	385	360	320	315	335	330	325	320	275	260	225	215	215	-40.3	-32.8
Finland	135	145	165	190	210	220	235	260	230	235	255	250	250	265	255	245	230	215	215	-17.3	-18.9
France	1.185	1.360	1.470	1.705	1.920	2.090	2.315	2.585	2.460	2.255	2.430	2.350	2.445	2.440	2.265	2.060	1.915	1.880	1.820	-29.6	-25.4
Greece	95	115	115	125	135	150	170	200	185	195	210	215	230	245	245	240	245	235	235	17.5	-4.1
Iceland	10	10	10	10	10	10	10	15	15	10	10	10	10	10	10	10	10	10	10	-33.3	—
Republic of Ireland	55	60	70	75	80	90	100	110	110	105	105	115	125	130	120	105	95	85	85	-22.7	-34.6
Italy	1.135	1.255	1.385	1.530	1.740	1.875	1.965	2.070	2.015	1.895	2.065	1.920	2.015	2.080	1.975	1.940	1.845	1.820	1.735	-16.2	-16.6
Netherlands	540	550	590	650	725	720	805	835	725	710	795	770	795	855	795	745	655	620	635	-24.0	-25.7
Norway	115	120	135	150	165	165	170	175	160	165	180	180	195	200	200	190	180	180	180	2.9	-10.0
Portugal	60	65	70	80	95	115	120	130	135	140	145	150	150	165	170	180	195	195	185	42.3	12.1
Spain	335	410	435	495	565	635	655	790	820	865	970	930	955	1.015	1.070	1.040	990	1.010	945	19.6	-6.9
Sweden	430	420	470	530	590	560	565	585	540	535	590	560	535	565	505	445	440	375	355	-39.3	-37.2
Switzerland	175	190	210	230	260	275	280	300	270	260	270	270	280	270	265	250	235	255	250	-16.7	-7.4
Turkey	95	115	130	140	155	180	200	250	255	275	310	340	315	300	300	315	335	330	350	40.0	16.7
United Kingdom	1.615	1.735	1.840	1.980	2.095	2.105	2.230	2.300	2.135	1.875	1.860	1.885	1.930	1.950	1.670	1.555	1.580	1.535	1.835	-20.2	-5.9
West Germany	1.830	1.695	2.135	2.420	2.655	2.745	2.885	3.070	2.760	2.655	2.655	2.855	2.960	3.050	2.725	2.465	2.355	2.340	2.340	-23.8	-23.3
Yugoslavia	70	80	95	120	140	180	205	225	235	245	265	280	295	315	300	285	280	270	290	28.9	-7.9
Cyprus Gibraltar Malta	15	15	20	20	20	25	25	25	25	20	25	25	25	25	25	30	30	30	30	20.0	20.0
Total Western Europe	**8.600**	**9.305**	**10.210**	**11.440**	**12.670**	**13.280**	**14.155**	**15.155**	**14.165**	**13.505**	**14.465**	**14.225**	**14.660**	**15.010**	**13.955**	**13.085**	**12.525**	**12.240**	**12.335**	**−18.6**	**−17.8**
Middle East	765	755	795	920	965	1.055	1.115	1.210	1.320	1.320	1.475	1.565	1.620	1.495	1.625	1.685	1.745	1.805	1.890	56.2	26.4
Africa	630	700	735	795	855	900	920	1.010	1.035	1.050	1.155	1.205	1.290	1.360	1.485	1.565	1.625	1.645	1.700	68.3	25.0
Japan	2.005	2.465	2.850	3.390	4.000	4.435	4.735	5.460	5.270	5.020	5.190	5.350	5.420	5.485	4.935	4.690	4.395	4.390	4.550	-16.7	-17.0
Southeast Asia	500	700	810	885	1.005	1.110	1.255	1.430	1.470	1.490	1.630	1.755	1.965	2.230	2.275	2.310	2.270	2.290	2.350	64.3	5.4
South Asia	390	415	455	535	540	565	585	635	600	610	665	705	760	775	825	890	935	955	1.005	58.3	29.7
Australasia†	455	495	540	575	620	650	660	725	750	735	770	800	795	805	770	760	745	720	750	3.4	-6.8
Total Non-Communist World	**28.510**	**30.590**	**33.180**	**36.305**	**39.175**	**41.245**	**44.130**	**47.605**	**46.040**	**44.860**	**47.690**	**49.160**	**50.575**	**51.215**	**48.585**	**46.740**	**45.235**	**44.800**	**45.715**	**− 4.0**	**−10.7**
COMMUNIST																					
China	280	275	300	400	560	725	855	1.065	1.225	1.350	1.530	1.630	1.705	1.835	1.765	1.705	1.660	1.705	1.720	61.5	-6.3
U.S.S.R.	3.900	4.250	4.515	4.815	5.310	5.655	6.115	6.595	7.280	7.520	7.780	8.125	8.480	8.640	8.795	8.985	9.075	9.115	9.040	37.1	4.6
Others	860	1.010	1.105	1.280	1.395	1.535	1.665	1.785	1.855	1.990	2.165	2.315	2.380	2.435	2.470	2.480	2.450	2.420	2.395	34.2	-1.6
Total Communist	**5.040**	**5.535**	**5.920**	**6.495**	**7.265**	**7.915**	**8.635**	**9.445**	**10.360**	**10.860**	**11.475**	**12.070**	**12.565**	**12.910**	**13.030**	**13.170**	**13.185**	**13.240**	**13.155**	**39.3**	**1.9**
Total World	**33.550**	**36.125**	**39.100**	**42.800**	**46.440**	**49.160**	**52.765**	**57.050**	**56.400**	**55.720**	**59.165**	**61.230**	**63.140**	**64.125**	**61.615**	**59.910**	**58.420**	**58.040**	**58.870**	**3.2**	**− 8.2**

*U.S. processing gain has been deducted from local domestic product demand. †Includes Australia, New Zealand, Papua New Guinea and South West Pacific Islands

Source: British Petroleum

per year. There has been a substantial shift in the market share of the various forms of primary energy. Over the period 1972 through 1983 oil's share of total worldwide primary energy fell from 46% to 40.3%. And then dropped to 39.5% in 1984. Although there have been year to year fluctuations in relative market shares all other primary fuels gained market share at the expense of oil over this period.

Natural gas moved up from 18.6% in 1972 to 19.6% in 1984. Coal increased from 28.9% in 1972 to 30.3% in 1984. Nuclear power supplied only 0.7% of the energy in 1972 and 3.9% in 1984. Water power was also up from 5.8% in 1972 to 6.7% in 1984.

The rapid rise in the price of oil relative to other fuels led to fuel switching. This is particularly true for heavy industry and electric utilities. With the high price, oil has become the "swing fuel" supplying energy when other fuels are not available At the present time there is a virtual gas glut in Europe and gas consumption is expected to increase at the expense of oil and possibly other fuels. Total world energy consumption moved up 28% over the 1972–1984 period while energy from oil moved up only 9.7%.

The rapid rise in oil prices made the consumers, worldwide, oil energy cost conscious. Where possible fuel switching to less costly fuels took place. In general, energy costs had risen enough to become a major concern in the economics of industrial production and in the cost of living, and substantial price induced conservation took place.

Oil's share of total primary energy consumption should continue to fall, primarily due to the substitution of cheaper fuel sources for electric power generation and for industrial purposes. The coal and nuclear share of energy consumption should continue to grow.

However, during the next few years oil's share of the total market will drop only marginally. The drop in crude prices has made oil more competitive with other fuel sources and also has slowed investment in conservation. By the end of the forecast period, 1990, it is expected that oil energy consumption will be growing faster than total energy.

Non communist worldwide demand for oil products followed two distinct trends from 1972 through 1983. From 1972 through 1979 free world demand was on the rise increasing 16.1% over this seven year span. From 1979 through 1983 demand for oil fell as price induced conservation took over. Consumption dropped 12.5% over this four year time period. The net effect was that free world demand in 1983 was up only 1.5% above 1972. There was a reversal of this downward trend in 1984 as lower prices and economic activity boosted demand 2.0%.

This is expected to be the start of a new upward trend in oil demand. Lower oil prices, substantially lower when adjusted for inflation, are expected to couple with increased economic activity to boost demand throughout the forecast period. Demand is expected to move up slowly through the early years 1985–1987 due to slow economic growth. Demand growth is expected to accelerate in the later years 1988–1990. Overall demand in 1990 is expected to be 10.8% above 1985.

In addition to the price induced conservation reducing demand through increased oil energy efficiency, fuel switching has had an impact. It has helped to reduce overall demand for petroleum products and also changed the proportion of petroleum products consumed.

World primary energy consumption

	1973	1976	1979	1982	1983	1984	% change 84/73	% change 84/79
	(Million barrels oil equivalent)							
U.S.	13,289	13,217	14,031	12,666	12,600	13,198	– 0.7	5.9
Canada	1,399	1,515	1,626	1,575	1,554	1,604	14.7	1.4
Total North America	**14,688**	**14,732**	**15,657**	**14,241**	**14,154**	**14,801**	**0.8**	**– 5.5**
Latin America	1,734	1,938	2,309	2,580	2,584	2,645	52.5	14.6
Total Western Hemisphere	**16,422**	**16,670**	**17,966**	**16,821**	**16,738**	**17,446**	**6.2**	**– 2.9**
Western Europe								
Austria	174	174	194	179	177	183	5.2	5.7
Belgium & Luxembourg	372	365	375	337	323	339	8.9	9.6
Denmark	144	141	147	122	116	124	– 13.9	– 15.6
Finland	131	135	158	157	157	159	21.4	0.6
France	1,364	1,343	1,414	1,333	1,333	1,371	0.5	3.0
Greece	112	137	128	123	128	133	18.8	3.9
Iceland	15	15	14	11	11	11	26.7	21.4
Republic of Ireland	54	53	65	61	60	60	11.1	7.7
Italy	1,011	1,046	1,097	1,030	1,015	1,028	1.7	6.3
Netherlands	564	559	575	496	475	489	– 13.3	– 15.0
Norway	206	225	232	237	226	239	16.0	3.0
Portugal	66	65	83	91	88	88	33.3	6.0
Spain	424	494	553	555	581	583	37.5	5.4
Sweden	299	313	323	291	281	292	2.3	9.6
Switzerland	175	166	180	188	195	189	8.0	5.0
Turkey	132	166	172	203	207	225	70.5	30.8
United Kingdom	1,648	1,520	1,627	1,421	1,423	1,407	– 14.6	13.5
West Germany	1,942	1,903	2,104	1,830	1,840	1,912	– 1.5	9.1
Yugoslavia	212	239	285	298	301	314	48.1	10.2
Cyprus/Gibraltar/Malta	10	10	11	12	12	12	20.0	9.1
Total Western Europe	**9,055**	**9,069**	**9,737**	**8,975**	**8,949**	**9,158**	**1.1**	**– 5.9**
Middle East	638	751	787	931	960	1,002	57.1	– 27.3
Africa	720	863	1,121	1,334	1,379	1,433	99.0	27.8
Japan	2,549	2,527	2,711	2,500	2,510	2,654	4.1	2.1
Southeast Asia	678	769	1,052	1,106	1,155	1,212	78.8	15.2
South Asia	757	839	955	1,206	1,273	1,318	74.1	38.0
Australasia*	488	557	631	654	651	688	41.0	9.0
Total Non-Communist World	**31,307**	**32,045**	**34,960**	**33,527**	**33,615**	**34,911**	**11.5**	**– 0.1**
Communist								
China	2,657	3,206	3,932	3,834	4,056	4,300	61.8	9.4
U.S.S.R.	6,407	7,452	8,312	9,115	9,430	9,692	51.3	16.6
Others	2,933	3,360	3,670	3,792	3,793	3,886	32.5	5.9
Total Communist	**11,997**	**14,018**	**15,914**	**16,741**	**17,279**	**17,877**	**49.0**	**12.3**
Total World	**43,304**	**46,063**	**50,874**	**50,268**	**50,894**	**52,788**	**21.9**	**3.8**

*Includes Australia, New Zealand, Papua New Guinea, and South West Pacific Islands.

Worldwide petroleum product consumption

	1973	1976	1979	1982	1983	1984	% change 79/73	% change 84/79	% change 84/73
	(million barrels)								
U.S. and Canada	6609.5	6657.9	7022.9	5705.7	5666.8	5801.0	6.3	– 17.4	– 12.2
Gasoline	2487.8	2565.5	2619.0	2366.1	2387.4	2427.7	5.3	– 7.3	– 2.4
Middle distillates	1663.2	1712.3	1893.3	1537.1	1543.7	1628.0	13.8	– 14.0	– 2.1
Fuel oil	1214.6	1201.4	1198.5	737.4	632.6	611.3	1.3	– 49.0	– 49.7
Other	1243.9	1178.7	1312.1	1065.1	1103.1	1134.0	5.5	– 13.6	– 8.8
Western Europe and Japan	7462.0	7064.6	7316.8	5957.1	5818.5	5905.0	– 1.9	– 19.3	– 20.9
Gasoline	1285.7	1304.7	1416.2	1266.6	1295.9	1305.5	10.1	– 7.8	1.5
Middle distillates	2196.1	2171.1	2332.4	2004.8	2026.0	2079.5	6.2	– 10.8	– 5.3
Fuel oil	3023.6	2712.1	2605.8	1790.0	1601.6	1598.7	– 13.8	– 38.6	– 47.1
Other	956.6	876.7	962.4	895.7	895.0	921.3	0.6	– 4.3	– 3.7
Rest of World*	3008.3	3336.6	3901.0	4278.5	4263.9	4378.2	29.7	12.2	45.5
Gasoline	574.7	620.9	739.6	837.8	839.3	854.7	28.7	15.6	48.7
Middle distillates	872.3	1090.7	1253.4	1427.9	1422.8	1467.5	43.7	17.1	68.2
Fuel oil	1136.9	1153.7	1374.4	1430.1	1416.2	1453.5	20.9	5.8	27.9
Other	424.4	471.3	533.6	582.7	585.6	602.5	25.7	12.9	42.0
Total World*	17079.8	17059.1	18240.7	15941.3	15749.2	16084.2	6.8	– 11.8	– 5.8
Gasoline	4348.2	4491.1	4774.8	4470.6	4522.6	4587.8	9.8	3.9	5.5
Middle distillates	4731.6	4974.1	5479.2	4969.7	4992.5	5175.0	15.8	– 5.6	9.4
Fuel oil	5375.1	5067.2	5178.6	3957.5	3650.3	3663.5	– 3.7	– 29.3	– 31.8
Other	2624.9	2526.7	2808.1	2543.5	2583.8	2657.9	7.0	– 5.4	1.3

*Excludes communist areas

Source: British Petroleum

The impact of competitive fuels, coal, nuclear, and water power is most evident in the consumption of heavy fuel oil. Free world fuel oil demand increased a modest 4.1% from 1972 to 1979 but then fell 29.5% from 1979 to 1983. Consumption of fuel oil in 1983 was 26.6% lower than 1972. This is the major product from oil that is most competitive with other fuels.

Fuel oil consumption increased marginally, 0.4% in 1984. Lower prices may make it more competitive in the future.

Over the 1972–1983 period gasoline consumption moved up 9.4%. A revival of U.S. demand boosted it an aditional 1.4% in 1984. Middle distillate demand increased 13.3% from 1972 to 1983, and then jumped another 3.7% in 1984. There is a direct relationship between economic growth and middle distillate demand. The demand for all other miscellaneous petroleum products was up 5.2%, 1972–1983, and up another 2.9% in 1984. This shift in product demand patterns has put pressure on refiners to produce a higher yield of lighter products.

From a geographical perspective, the shift is most pronounced in the United States, Western Europe, and Japan. In these areas there has been a major shift away from fuel oil and an increase in demand for gasoline and middle distillates. In the rest of the free world, the shift has not been as pronounced but is also in evidence.

In the United States the fuel oil share of the total barrel dropped from 17.1% in 1972 to 10.5% in 1984. Over the same period gasoline moved up from 38.8% to 42.0%. And middle distillates increased from 24.7% to 27.8%.

In Canada the fuel oil share went from 21.2% in 1972 to 11.4% in 1984.

Gasoline moved from 30.9% to 40.2%. And middle distillates from 21.2% to 31.3%.

In Western Europe and Japan the drop in fuel oil demand was even more pronounced. In Europe fuel oil demand dropped from 36.5% of the market in 1972 to 24.0% in 1984. Gasoline in Europe moved up from 17.9% to 23.2%. And middle distillates shifted from 33% to 37.1%. In Japan fuel oil fell from 53.3% of oil product consumption in 1972 to 35.5% in 1984. Gasoline moved from 16.3% to 18.9% and middle distillates from 17.5% to 30.2%.

There are obvious geographical differences with gasoline being a much greater share of the North American market and fuel oil relatively more important but diminishing in importance elsewhere.

Looking at product consumption from the geographical perspective what stands out most is the difference in trends between the industrial countries and the other less developed countries. The consumption in the total U.S., Canada, Western Europe, and Japan, was down 10.8% in 1984 from 1972. For the remainder of the non communist world consumption in 1984 was up 54% from 1972.

It should be noted that the recent strong U.S. dollar relative to other currencies has resulted in oil prices being higher outside the U.S. Export crudes, particularly from OPEC, are denominated in U.S. dollars. In several European countries oil prices and therefore petroleum product prices have actually risen from 1981 to the present. This has tended to suppress demand for petroleum products in Europe and other areas in recent years.

Adjusted for inflation the official U.S. dollar price of Saudi light crude fell 23% from 1981 through 1983. The price for Japan fell only 7%, Italy down only 3%, West Germany down 0.7%. The price in France was up 11% and the United Kingdom up 15%. When the value of the dollar falls lower oil prices could stimulate demand outside the U.S.

The alteration of the historical energy and economic activity relationship was primarily due to the rapid increase in the price of oil. It also was aided by the sharp increase in general worldwide inflation, raising all energy costs.

Oil, and to a certain extent all energy costs, increased more rapidly than other economic production costs. This made energy a more important consideration in business decision making. The result was an adjustment in investment decisions with more concern for cost cutting energy saving investments. This adjustment in investment patterns brought relatively more concern for energy cost cutting than in investment to increase output. This contributed to the drop in demand for energy and oil but also contributed to an eventual worldwide recession in 1983.

From 1972 to 1982 the posted price of Saudi Arabian marker crude increased from $2.48/bbl to $34/bbl, an increase of 1,271% or $31.22/bbl. The real price adjusted for inflation increased 546%. This far surpassed the average price increase for all commodities of 151% over this period. The sharp increase in prices did not initially slow demand for petroleum products. There is some evidence that the price of crude oil was below the market equilibrium price in the 1960's, and this encouraged demand. Therefore, the initial 1973–74 increase was easily absorbed. Another reason that demand did not appear to react to the initial price increase was that many energy and oil conservation investments take time to exert a measurable impact. In the industrial, utility and residential/commercial sectors it may take up to 10 years or more before the majority of the impact from conservation investment is felt. The adjustment in the transportation sector can be very rapid, but since there are fewer substitutes long term conservation is reduced.

After the initial price shock in 1973–74 the real price of oil fell during the 1974–78 period, and demand adjustment was muted. However, the 1979–80 price boost produced a much more dramatic adjustment. That price jump coupled with forecasts of future rapidly rising oil prices led to a sharp drop in oil use.

Between 1978 and 1981 the world price of oil jumped another 152%. Responding to this rapid increase in prices the demand for oil in the non communist world peaked in 1979 and dropped 13.7% by 1983. Over this 4 year period the worldwide demand response to the price increase was an 0.9% drop in demand for every 10% increase in price. This is relatively inelastic demand. But it does show that there is a demand response to price that must be considered when forecasting demand for oil products.

The drop in oil demand as a response to prices, and the worldwide economic slow down, put downward pressure on crude prices. A massive crude production capacity surplus developed when demand fell. The result was a peaking of crude prices in March 1981. Although the official price of the OPEC marker Saudi light crude was boosted to $34/bbl in 1981, actual average transaction prices were falling.

The Saudi light crude marker price was lowered to $29 in early 1983 and again to $28 at the beginning of 1985. This is a 17.6% drop in the official marker crude price. The U.S. refiner acquisition cost of imported crude oil peaked in February 1981 at $39/bbl. It had fallen to $27.05/bbl in February 1985, a drop of 30.6% in four years.

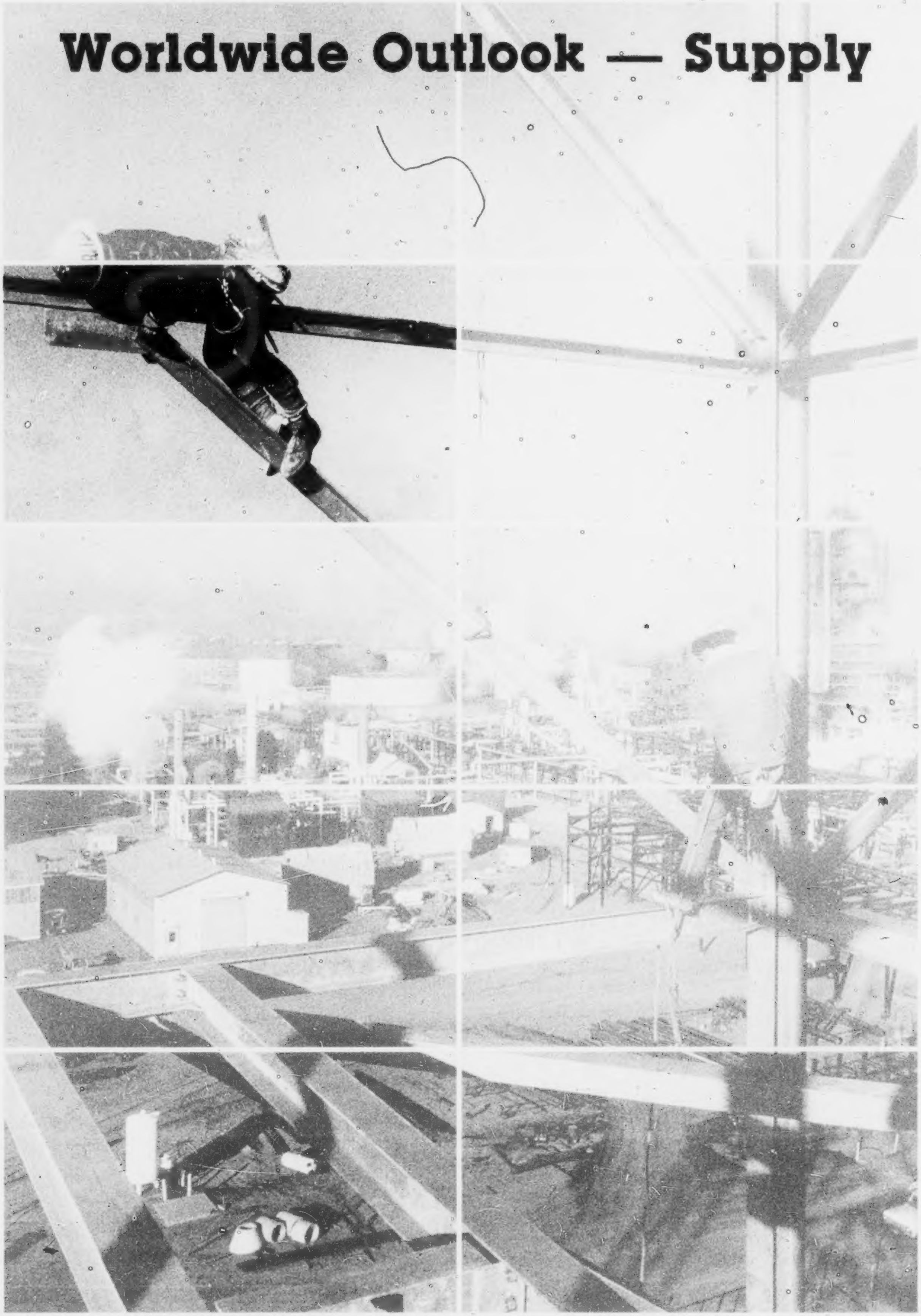
With the massive excess capacity overhanging the crude market, it is highly unlikely that crude prices will be making any substantial upward move in the near future. It is much more likely that prices will continue to decline until there is a rebound in demand. The average worldwide export price is expected to continue to slide into 1988, falling another 20% to $22/bbl. The present price is an estimated $27.35/bbl. This will fall to $25.75/bbl in 1985 and continue to slide because of sluggish demand and surplus capacity.

Inflation is not dead, and, therefore, real oil prices are and will continue to decline. This should stimulate demand for oil products by slowing investment in conservation. It is unlikely, however, that demand will increase sufficiently, in the near future, to eliminate the surplus capacity and put any upward pressure on prices. Prices are expected to move back up late in the forecast period 1988–1990, when demand is on the rise.

THE OUTLOOK — WORLDWIDE DEMAND

	1985	1986	1987	1988	1989	1990	Change 1985 to 1990	% Change 1985 to 1990
World Energy Demand (million barrels oil equivelant)	52,895	53,685	53,690	54,760	56,950	58,375	+5,480	+10.4
World Oil Demand (thousands barrels/day)	59,650	60,185	60,190	61,695	64,160	66,085	+6,435	+10.8
Non-Communist Demand (thousand barrels/day)	46,240	46,630	46,495	47,855	50,180	51,955	+5,715	+12.4
PRODUCT DEMAND (thousand barrels/day)								
Non-Communist Areas								
Motor gasoline	12,800	12,920	12,900	13,180	13,640	13,980	+1,180	+ 9.2
Middle distillates	14,765	15,085	15,195	15,725	16,225	16,790	+2,025	+13.7
Fuel oil	9,650	9,500	9,300	9,535	9,915	10,445	+ 795	+ 8.2
Other	9,025	9,125	9,100	9,415	10,400	10,740	+1,715	+19.0
Crude Oil Price (average world export price) ($/barrel)	$25.75	$24.50	$22.50	$22.00	$23.00	$23.50	–$2.25	– 8.7

Worldwide Outlook — Supply



Worldwide Outlook—Supply

THE OTHER SIDE of the worldwide outlook equation is supply. Due to the drop in demand world oil production peaked in 1979. The rapid rise in the crude oil price induced conservation throughout the world and led back to a drop in output at the wellhead.

Total liquids production (crude oil, condensate and natural gas liquids) peaked at 65.775 million b/d in 1979. The second price shock followed soon after and led to a sharp drop in production. Adjustments to the rapid increase in energy costs also led to a slow down in economic activity which further contributed to a drop in demand for oil. World production fell for four consecutive years, 1979–1983, dropping to 56.705 million b/d in 1983. This was a drop of 9,070 million b/d, 13.8%. A rapid shift to other energy sources for economic growth was occurring over these years. Stimulated by the surge in economic activity worldwide crude production rebounded in 1984, moving up 2.1% to 57.8 million b/d. Worldwide production in 1984 was actually 1.4% below output for 10 years earlier, 1974, when output was 58.62 million b/d.

The drop in world crude production mirrored the drop in demand for petroleum products, which was a direct result of the sharp increase in the price of oil products, resulting from the OPEC crude price increases.

Part of the 1984 rebound in demand resulted from a slide in crude oil prices since 1981. The drop in prices was mainly due to the development of a massive excess crude oil capacity worldwide. Both increased output in non-OPEC countries and the drop in demand contributed to the excess capacity. In fact, the real key to understanding the present world oil supply situation and crude oil price developments, is understanding the worldwide crude production capacity situation.

Over time, as more and more oil was required to fuel worldwide economic growth, production capacity was expanded to meet the demand. Production facilities were installed to allow a buffer for maintenance and other non-routine contingencies. Generally output was planned to average about 92% of installed capacity. The international oil companies as a rule obtained concessions and developed the lower cost areas first. These were the profilic fields of the OPEC countries.

Capacity seldom exceeded demand because the rate of installation of new capacity was regulated to meet demand growth.

Worldwide oil reserves

	Jan. 1 (1,000 bbl)														
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	Change 1985-1975	% change 1985/1975
Australia	2,121,460	2,300,000	2,300,000	1,700,000	1,380,000	2,000,000	2,100,000	2,130,000	2,360,000	1,709,000	1,622,077	1,586,000	1,430,900	– 869,100	– 37.8
Brunei	1,500,000	1,600,000	2,500,000	2,000,000	1,625,000	1,550,000	1,480,000	1,800,000	1,710,000	1,630,000	1,240,000	1,390,000	1,400,000	– 1,100,000	– 44.0
India	834,000	779,000	834,000	913,000	3,000,000	3,000,000	2,900,000	2,600,000	2,580,000	2,672,000	3,416,400	3,485,000	3,500,000	+ 2,666,000	+ 319.7
Indonesia	10,005,000	10,500,000	15,000,000	14,000,000	10,500,000	10,000,000	10,200,000	9,600,000	9,500,000	9,800,000	9,550,000	9,100,000	8,650,000	– 6,350,000	– 42.3
Malaysia	*	*	*	2,500,000	2,430,000	2,500,000	2,800,000	2,800,000	3,000,000	2,800,000	3,325,000	3,000,000	3,000,000	+ 3,000,000	—
Others	461,800	456,040	413,700	121,230	456,140	699,270	527,200	425,200	480,500	541,800	602,600	408,400	549,000	+ 135,300	+ 32.7
Total Asia-Pacific	**14,922,260**	**15,635,040**	**21,047,700**	**21,234,230**	**19,391,140**	**19,479,270**	**20,007,200**	**19,355,200**	**19,630,500**	**19,150,800**	**19,756,077**	**18,969,400**	**18,529,900**	**– 2,517,800**	**– 12.0**
Norway	2,000,000	4,000,000	7,300,000	7,000,000	5,660,000	6,000,000	5,900,000	5,750,000	5,500,000	7,620,000	6,800,000	7,660,000	8,300,000	+ 1,000,000	+ 13.7
United Kingdom	5,000,000	10,000,000	15,700,000	16,000,000	16,800,000	19,000,000	16,000,000	15,400,000	14,800,000	14,800,000	13,900,000	13,150,000	13,590,000	– 2,110,000	– 13.4
Others	5,082,000	1,990,500	2,814,000	2,487,700	2,078,810	1,862,500	2,066,000	2,626,400	2,785,000	2 214,500	2,223,680	2,209,480	2,535,500	– 278,500	– 9.9
Total Western Europe	**12,082,000**	**15,990,500**	**25,814,000**	**25,487,700**	**24,538,810**	**26,862,500**	**23,966,000**	**23,776,400**	**23,085,000**	**24,634,500**	**22,923,680**	**23,019,480**	**24,425,500**	**– 1,388,500**	**– 5.4**
Abu Dhabi	20,768,000	21,500,000	30,000,000	29,500,000	29,000,000	31,000,000	30,000,000	28,000,000	29,000,000	30,600,000	30,510,000	30,400,000	30,500,000	+ 500,000	+ 1.7
Divided Zone	16,000,000	17,500,000	17,300,000	6,400,000	6,300,000	6,200,000	6,480,000	6,260,000	6,060,000	6,500,000	5,840,000	5,695,000	5,420,000	– 11,880,000	– 68.7
Dubai	2,000,000	2,500,000	2,420,000	1,350,000	1,500,000	1,400,000	1,300,000	1,400,000	1,400,000	1,270,000	1,440,000	1,440,000	1,440,000	– 980,000	– 40.5
Iran	65,000,000	60,000,000	66,000,000	64,500,000	63,000,000	62,000,000	59,000,000	58,000,000	57,500,000	57,000,000	55,308,000	51,000,000	48,500,000	– 17,500,000	– 26.5
Iraq	29,000,000	31,500,000	35,000,000	34,300,000	34,000,000	34,500,000	32,100,000	31,000,000	30,000,000	29,700,000	41,000,000	43,000,000	44,500,000	+ 9,500,000	+ 27.1
Kuwait	64,900,000	64,000,000	72,800,000	68,000,000	67,400,000	67,000,000	66,200,000	65,400,000	64,900,000	64,480,000	64,230,000	63,900,000	90,000,000	+ 17,200,000	+ 23.6
Oman	5,000,000	5,250,000	6,000,000	5,900,000	5,800,000	5,650,000	2,500,000	2,400,000	2,340,000	2,570,000	2,730,000	2,790,000	3,500,000	– 2,500,000	– 41.7
Qatar	7,000,000	6,500,000	6,000,000	5,850,000	5,700,000	5,600,000	4,000,000	3,760,000	3,585,000	3,434,000	3,425,000	3,330,000	3,350,000	– 2,650,000	– 44.2
Saudi Arabia	138,000,000	132,000,000	164,500,000	148,600,000	151,400,000	150,000,000	165,700,000	163,350,000	165,000,000	164,600,000	162,400,000	166,000,000	169,000,000	+ 4,500,000	+ 2.7
Syria	7,250,000	7,100,000	1,500,000	2,240,000	2,200,000	2,150,000	2,080,000	2,000,000	1,940,000	1,890,000	1,521,000	1,490,000	1,450,000	– 50,000	– 3.3
Others	934,000	2,312,500	2,338,200	1,770,570	1,380,000	666,000	636,000	377,300	346,000	795,950	881,893	1,055,800	720,750	– 1,617,450	– 69.2
Total Middle East	**355,852,000**	**350,162,500**	**403,858,200**	**368,410,570**	**367,680,000**	**366,166,000**	**369,996,000**	**361,947,300**	**362,071,000**	**362,839,950**	**369,285,893**	**370,100,800**	**398,380,750**	**– 5,477,450**	**– 1.4**
Algeria	†47,000,000	7,640,000	7,700,000	7,370,000	6,800,000	6,600,000	6,300,000	8,440,000	8,200,000	8,080,000	9,440,000	9,220,000	9,000,000	+ 1,300,000	+ 16.9
Angola-Cabinda	1,200,000	1,500,000	1,175,000	1,300,000	1,210,000	1,160,000	1,115,000	1,200,000	1,200,000	1,450,000	1,635,000	1,700,000	1,800,000	+ 625,000	+ 53.2
Congo Republic	5,000,000	4,888,000	4,874,000	2,450,000	285,000	360,000	315,000	400,000	660,000	1,300,000	1,550,000	400,000	480,000	– 4,394,000	– 90.2
Egypt	5,200,000	5,125,000	3,700,000	3,900,000	1,950,000	2,450,000	3,200,000	3,100,000	2,900,000	2,930,000	3,325,000	3,450,000	3,200,000	– 500,000	– 13.5
Libya	30,400,000	25,500,000	26,600,000	26,100,000	25,500,000	25,000,000	24,300,000	23,500,000	23,000,000	22,600,000	21,500,000	21,270,000	21,100,000	– 5,500,000	– 20.7
Nigeria	15,000,000	20,000,000	20,900,000	20,200,000	19,500,000	18,700,000	18,200,000	17,400,000	16,700,000	16,500,000	16,750,000	16,550,000	16,650,000	– 4,250,000	– 20.3
Tunisia	1,000,000	950,000	1,100,000	1,065,000	2,700,000	2,670,000	2,300,000	2,250,000	1,652,000	1,690,000	1,860,000	1,820,000	1,514,000	+ 414,000	+ 37.6
Others	1,602,000	1,700,750	2,250,450	2,700,220	2,625,200	2,260,150	2,162,125	782,100	836,375	1,621,630	1,761,690	2,497,020	1,796,550	– 453,900	– 20.2
Total Africa	**106,402,000**	**67,303,750**	**68,299,450**	**65,085,220**	**60,570,200**	**59,200,150**	**57,892,125**	**57,072,100**	**55,148,375**	**56,171,630**	**57,821,690**	**56,907,020**	**55,540,550**	**– 12,758,900**	**– 18.7**
Argentina	4,900,000	2,500,000	2,346,000	2,465,000	2,300,000	2,503,000	2,400,000	2,400,000	2,457,000	2,650,000	2,590,000	2,428,700	2,266,000	– 80,000	– 3.4
Brazil	857,000	799,000	775,000	780,000	800,000	880,000	1,200,000	1,220,000	1,300,000	1,325,060	1,750,000	1,800,000	1,976,000	+ 1,201,000	+ 155.0
Ecuador	5,750,000	5,675,000	2,500,000	2,450,000	1,700,000	1,640,000	1,170,000	1,100,000	1,100,000	850,000	1,400,000	1,675,000	1,400,000	– 1,100,000	– 44.0
Mexico	2,800,000	3,600,000	13,582,000	9,500,000	7,000,000	14,000,000	16,000,000	31,250,000	44,000,000	56,990,000	48,300,000	48,000,000	48,600,000	+ 35,018,000	+ 257.8
Venezuela	13,700,000	14,000,000	15,000,000	17,700,000	15,270,000	18,200,000	18,000,000	17,870,000	17,950,000	20,300,000	21,500,000	24,850,000	25,845,000	+ 10,845,000	+ 72.3
United States	36,823,271	34,700,249	35,299,839	33,000,000	31,300,000	29,500,000	28,500,000	26,500,000	26,400,000	29,785,000	29,785,000	27,300,000	27,300,000	– 7,999,839	– 22.7
Canada	10,200,000	9,424,170	9,400,000	7,100,000	6,200,000	6,000,000	6,000,000	6,800,000	6,400,000	7,300,000	7,020,000	6,730,000	7,075,000	– 2,325,000	– 24.7
Others	4,594,750	5,066,250	6,375,000	2,473,000	2,538,950	3,147,000	2,476,500	2,632,500	2,682,837	2,867,210	2,942,066	2,922,200	3,228,700	– 3,146,300	– 49.4
Total Western Hemisphere	**79,625,021**	**75,764,669**	**85,277,839**	**75,468,000**	**67,108,950**	**75,870,000**	**75,746,500**	**89,772,500**	**102,289,837**	**122,067,270**	**115,287,066**	**115,705,900**	**117,690,700**	**+ 32,412,861**	**+ 38.0**
Total Non-Communist	**568,883,281**	**524,856,459**	**604,297,189**	**555,685,720**	**539,290,000**	**547,847,920**	**547,607,825**	**551,623,500**	**562,224,712**	**584,864,150**	**585,074,406**	**584,702,600**	**614,567,400**	**+ 10,270,211**	**+ 1.7**
China	19,500,000	20,000,000	25,000,000	20,000,000	20,000,000	20,000,000	20,000,000	20,000,000	20,500,000	19,895,000	19,485,000	19,100,000	19,100,000	– 5,900,000	– 23.6
U.S.S.R.	75,000,000	80,000,000	83,400,000	80,400,000	78,100,000	75,000,000	71,000,000	67,000,000	63,000,000	63,000,000	63,000,000	63,000,000	63,000,000	– 20,400,000	– 24.5
Others	3,500,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	3,000,000	2,800,000	2,950,000	2,630,000	2,500,000	2,000,000	– 1,000,000	– 33.3
Total Communist	**98,000,000**	**103,000,000**	**111,400,000**	**103,400,000**	**101,100,000**	**98,000,000**	**94,000,000**	**90,000,000**	**86,300,000**	**85,845,000**	**85,115,000**	**84,600,000**	**84,100,000**	**– 27,300,000**	**– 24.5**
Total World	**666,883,281**	**627,856,459**	**715,697,189**	**659,085,720**	**640,390,000**	**645,847,920**	**641,607,825**	**641,623,500**	**648,524,712**	**670,709,150**	**670,189,406**	**669,302,600**	**698,667,400**	**– 17,029,789**	**– 2.4**
Total OPEC	**465,998,000**	**421,815,000**	**485,306,000**	**450,182,000**	**440,685,000**	**440,185,000**	**445,186,000**	**435,831,300**	**434,580,000**	**436,709,000**	**436,858,000**	**448,420,000**	**476,415,000**	**– 8,891,100**	**– 1.8**
OPEC as % of world	69.9%	67.2%	67.8%	68.3%	68.9%	68.2%	69.4%	68.0%	67.1%	65.2%	65.2%	67.0%	68.2%	—	—

*Included in Brunei. †Government figure. Later revised significantly downward.

Source: Oil & Gas Journal

As demand for oil increased in the 1970's, it was mainly OPEC production that filled the need. By 1976 OPEC output represented 51.7% of total worldwide output, and 65.5% of non communist world demand. OPEC production actually peaked in 1977 at 31.69 million b/d, 50.7% of worldwide production, and 64.4% of non communist production. OPEC output remained above 30 million b/d in 1978 and 1979, with 1979 at 31.47 million b/d. This was 47.8% of total world demand and 61.3% of non communist demand. The rapid rise in prices had stimulated the development of crude production in non-OPEC countries. And non-OPEC output was beginning to supply a greater proportion of demand.

In the late 1960's and early 1970's, as worldwide demand was on the rise, the OPEC countries gained control of their oil resources from the international oil companies. The international oil companies had been efficient at exploration and production. The price was kept low by continuous development of additional oil resources in the face of rising demand. When OPEC gained control they took advantage of the dependency on oil and the worldwide expansion that was being fueled by oil. They chose to test the demand response to higher prices (elasticity of demand) and raised prices sharply in 1973–1974. Demand continued to rise so they boosted prices again in 1979–1981.

The capacity situation changed drastically after the OPEC price hikes. Through the 1960's and up until 1973, excess capacity in the worldwide oil industry was 7–8%. Excess capacity was 7% of total capacity and 8% of production. After the price hike, excess capacity began to increase and moved up to 10–12% in 1974 and as high as 19–25% in 1975. This was 19% of available capacity and 25% of production. The Iranian revolution helped drop excess capacity to the 9–10% level and allowed OPEC to push through the massive 1979–80 price increase.

But following 1979 the combination of declining demand and rising non-OPEC production has resulted in massive excess capacity. Most OPEC capacity had been put in place by 1977, but non-OPEC production had been stimulated by the increase in prices, and new capacity has been added continuously. Only the Iranian revolution and the Iran-Iraq war have kept the excess capacity situation in check. But by 1983 excess capacity was 15.6 million b/d, which was 29% of total capacity and 41% of total production/demand.

Excess capacity dropped only marginally in 1984 to 15.3 million b/d. This was still 28% of total available non communist capacity and 39% of total production. This excludes about 7 million b/d shut in due to the Iran-Iraq war. It is difficult to determine how much of that 7 million b/d is still available but a substantial proportion could probably be brought back on stream if required.

This massive excess production capacity has put downward pressure on prices and has been the reason for the drop in crude prices since 1981. The OPEC group has tried to rectify the situation by agreeing to a production limit. They have managed, to a substantial degree, to control their production, and this has somewhat stabilized prices. However, with the surplus capacity overhanging the market, it is unlikely that there will be any upward movement in prices in the near future. It is more likely that prices will continue to slide. OPEC production, particularly in the Persian Gulf area, is some of the lowest cost in the world. But the aggressive pricing policies of OPEC have resulted in OPEC oil being the highest priced in the world. The result has been that, where ever possible, OPEC oil

World oil production*

Country Area	1974	1975	1976	1977	1978	1979 1,000 b d	1980	1981	1982	1983	1984	% change 84/74	% change 84/79
NORTH AMERICA													
USA—Crude oil	8,795	8,375	8,130	8,245	8,710	8,550	8,595	8,570	8,650	8,685	8,750	0.5	2.3
USA—NGLs	1,690	1,635	1,605	1,620	1,565	1,585	1,575	1,610	1,550	1,560	1,635	3.3	3.2
Canada	2,000	1,735	1,605	1,610	1,575	1,770	1,725	1,545	1,485	1,515	1,555	−22.3	−12.1
Total North America	**12,485**	**11,745**	**11,340**	**11,475**	**11,850**	**11,905**	**11,895**	**11,725**	**11,685**	**11,760**	**11,940**	**− 4.4**	**0.3**
LATIN AMERICA													
Argentina	415	390	390	430	455	470	490	490	490	475	465	12.0	−1.1
Brazil	175	170	170	165	165	170	195	220	275	360	495	182.9	191.2
Colombia	170	160	145	140	130	150	125	135	145	155	170	—	13.3
Ecuador	175	160	185	190	205	215	205	210	210	240	255	45.7	18.6
Mexico	640	790	875	1,085	1,330	1,630	2,155	2,585	3,005	2,950	3,010	370.3	84.7
Trinidad	180	215	215	230	230	215	210	200	175	160	165	−8.3	−23.3
Venezuela	3,065	2,425	2,375	2,315	2,235	2,425	2,235	2,180	1,965	1,875	1,875	−38.8	−22.7
Others	165	150	150	160	215	255	280	275	295	260	270	63.6	5.9
Total Latin America	**4,985**	**4,460**	**4,505**	**4,715**	**4,965**	**5,530**	**5,895**	**6,295**	**6,560**	**6,475**	**6,705**	**34.5**	**21.2**
WESTERN EUROPE													
Austria	45	40	40	35	35	35	30	25	25	25	25	−44.4	−28.6
Denmark	†	5	5	10	10	10	5	15	35	45	45	—	350.0
France	20	20	20	20	20	25	30	35	50	50	60	200.0	140.0
Italy	20	20	20	20	25	30	35	25	30	40	40	100.0	33.3
Norway	35	190	280	275	350	385	525	505	500	620	710	1928.6	84.4
Turkey	65	60	50	55	55	55	45	45	45	45	40	−38.5	−27.3
United Kingdom	†	30	240	765	1,095	1,600	1,650	1,835	2,125	2,360	2,580	—	61.3
West Germany	120	115	110	105	100	95	90	90	85	80	80	−33.3	−15.8
Yugoslavia	70	80	80	80	85	85	85	85	85	85	80	14.3	−5.9
Others	65	65	65	45	45	60	65	60	95	145	140	115.4	133.3
Total Western Europe	**440**	**625**	**910**	**1,410**	**1,820**	**2,380**	**2,560**	**2,720**	**3,075**	**3,495**	**3,800**	**763.6**	**59.7**
MIDDLE EAST													
Abu Dhabi	1,410	1,400	1,595	1,665	1,450	1,465	1,345	1,135	885	860	340	−40.4	−42.7
Dubai	240	255	315	320	360	355	350	360	360	345	365	52.1	2.8
Iran	6,060	5,385	5,920	5,705	5,275	3,175	1,480	1,325	2,410	2,465	2,195	−63.8	−30.9
Iraq	1,970	2,260	2,415	2,350	2,560	3,475	2,645	895	1,010	1,105	1,170	−40.6	−66.3
Kuwait	2,330	1,885	1,965	1,835	1,945	2,270	1,430	965	705	900	985	−57.7	−56.6
Neutral Zone	540	500	465	390	470	570	545	375	315	310	420	−22.2	−26.3
Oman	290	340	365	340	315	295	285	325	325	390	420	44.8	42.4
Qatar	520	435	495	445	485	510	460	425	340	310	425	−18.3	−16.7
Saudi Arabia	8,350	6,970	8,525	9,235	8,315	9,555	9,990	9,985	6,695	5,225	4,690	−43.8	−50.9
Others	220	285	290	260	250	240	225	225	210	210	225	2.3	−6.3
Total Middle East	**21,930**	**19,715**	**22,350**	**22,545**	**21,425**	**21,910**	**18,755**	**16,015**	**13,255**	**12,120**	**11,735**	**−46.5**	**−46.4**
AFRICA													
Algeria	1,010	1,020	1,075	1,150	1,230	1,255	1,120	1,035	1,045	965	990	−2.0	−21.1
Egypt	230	295	325	415	480	525	590	690	705	775	915	297.8	74.3
Libya	1,520	1,480	1,930	2,065	1,985	2,090	1,830	1,220	1,135	1,140	1,115	−26.6	−46.7
Other North Africa	85	95	75	100	100	115	120	115	105	115	120	41.2	4.3
Gabon	200	225	225	220	210	205	175	150	155	150	155	−22.5	−24.4
Nigeria	2,260	1,785	2,065	2,085	1,895	2,300	2,055	1,440	1,285	1,235	1,405	−37.8	−38.9
Other West Africa	225	205	165	230	195	260	285	330	355	420	485	115.6	86.5
Total Africa	**5,530**	**5,105**	**5,860**	**6,265**	**6,095**	**6,750**	**6,175**	**4,980**	**4,785**	**4,800**	**5,185**	**− 6.2**	**−23.2**
ASIA AND AUSTRALASIA													
Japan	15	10	10	10	10	10	10	10	10	10	10	−33.3	—
Brunei	200	190	205	220	205	240	235	175	165	175	160	−20.0	−33.3
Indonesia	1,375	1,305	1,505	1,690	1,635	1,590	1,575	1,680	1,415	1,345	1,440	4.7	−9.4
Other Southeast Asia	85	105	170	195	220	295	290	260	310	475	555	552.9	88.1
South Asia	180	195	200	240	260	300	230	340	440	475	535	238.9	103.3
Australasia§	385	415	430	450	450	455	400	410	420	470	545	41.6	19.6
Total Asia and Australasia	**2,240**	**2,220**	**2,520**	**2,805**	**2,780**	**2,890**	**2,740**	**2,875**	**2,760**	**2,995**	**3,320**	**48.2**	**14.9**
Total Non-Communist World	**47,610**	**43,870**	**47,485**	**49,215**	**48,935**	**51,365**	**48,020**	**44,610**	**42,120**	**41,645**	**42,685**	**−10.3**	**−16.9**
COMMUNIST													
China	1,320	1,490	1,675	1,880	2,090	2,130	2,125	2,035	2,050	2,135	2,300	74.2	8.0
U.S.S.R.	9,290	9,935	10,520	11,055	11,595	11,870	12,215	12,370	12,430	12,520	12,415	33.6	4.6
Others	400	405	405	410	430	410	385	360	420	405	400	—	−2.4
Total Communist	**11,010**	**11,830**	**12,600**	**13,345**	**14,115**	**14,410**	**14,725**	**14,765**	**14,900**	**15,060**	**15,115**	**37.3**	**4.9**
Total World	**58,620**	**55,700**	**60,085**	**62,560**	**63,050**	**65,775**	**62,745**	**59,375**	**57,020**	**56,705**	**57,800**	**− 1.4**	**−12.1**
OPEC	31,055	27,530	31,090	31,690	30,275	31,470	27,450	23,390	19,935	18,475	18,345	−40.9	−41.7

*Includes natural gas liquids

†Less than 5 thousand barrels daily

§Includes Australia, New Zealand, Papua New Guinea, South West Pacific Islands

Source: British Petroleum

supplies have been replaced by domestic crude or other less costly imported crude.

Therefore, OPEC has become the swing producer meeting the gap between demand and non-OPEC production. Therefore, all excess capacity except for some minor exceptions, has been thrust upon OPEC. About 44% of installed OPEC capacity, 13.6 million b/d out of 31 million b/d, was shut in in 1984.

The OPEC cartel pricing policies have resulted in an oil industry turned upside down with the cheapest production shut in and the most expensive production producing at full capacity.

That aggressive OPEC pricing policy meant that when demand began to fall, it was at the expense of OPEC output. OPEC production peaked in 1977 at 31.7 million b/d. This was 64.4% of free world production.

By 1984 OPEC production had fallen to 18.3 million b/d, a drop of 42.1%. This was only 43% of total free world production.

In 1982, for the first time in its history OPEC production fell below 50% of free world production. In that year OPEC output was 19.935 million b/d, 47.3% of free world output of 42.12 million b/d.

Non-OPEC production spurred by the higher prices has been increasing steadily since 1975. This has been the supply response to the markedly higher oil prices. Non-OPEC output has increased 49% from 16.3 million b/d in 1975 to 24.3 million b/d in 1984. Obviously, the OPEC led increase in prices has made oil production economical in a number of other areas of the world.

The increases in non-OPEC production have occurred throughout the world. Major increases have been recorded in Brazil and Mexico in the Western Hemisphere. Norway and the United Kingdom have boosted production substantially in Western Europe. Elsewhere there have been large increases in Egypt and India. A number of these countries have become major exporters of crude oil and are in direct competition with the OPEC exporters.

In addition to increasing non-OPEC non-communist production, the U.S.S.R. has been increasing production and exports. This has added to the crude glut and increased the impact on OPEC. U.S.S.R. output moved up 33.6% between 1974 and 1984. They are now the world's largest producer.

There production actually fell 0.5% last year for the first time. There is some question as to whether production can be maintained. However, efforts are being made to replace oil with gas in the U.S.S.R. and maintain exports.

Total world production is expected to move up during the forecast period 1985–1990 but it won't be a steady rise. Production is expected to move up in 1985 and 1986 and then slip in 1987 along with a stagnation in economic activity. Production will then move up in the 1988–1990 period, reaching 64.7 million b/d. Production in 1990 will be up 11%, 6.4 million b/d above 1985.

Non-OPEC production will continue to rise throughout the period but the growth will slow toward the end of the period. Non-OPEC output will move up to 26.05 million b/d in 1990, an increase of 4.9%. OPEC production will fall from 1985 through 1987 before moving up along with demand.

By the end of the forecast period OPEC production will increase to 22.83 million b/d. This is 4.63 million b/d, 25.4% above 1985. Although this is above the stated OPEC production quotas the level of production will not be high enough to put any pressure on prices until the latter part of the forecast period 1989–1990.

Worldwide production of natural gas

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	% change 84/74
	(Billion cu ft)											
NORTH AMERICA												
USA	20,713	19,235	19,098	19,165	19,122	19,663	19,404	19,181	17,758	16,033	17,224	-16.8
Canada	2,658	2,701	2,717	2,850	2,744	2,944	2,709	2,642	2,607	2,454	2,556	-3.8
Total North America	**23,371**	**21,936**	**21,815**	**22,015**	**21,866**	**22,607**	**22,113**	**21,823**	**20,364**	**18,487**	**19,780**	**-15.4**
LATIN AMERICA												
Argentina	255	270	259	267	274	255	278	294	341	365	357	40.0
Bolivia	59	59	63	63	67	78	82	98	102	98	98	66.7
Chile	129	122	141	133	125	122	98	82	110	106	102	-21.2
Mexico	561	584	576	725	862	917	1,066	1,227	1,282	1,231	1,258	124.5
Trinidad	67	63	78	59	74	114	86	86	86	106	110	64.7
Venezuela	474	451	478	525	521	576	588	588	576	612	584	23.1
Others	118	125	129	145	157	165	169	184	188	235	278	136.7
Total Latin America	**1,662**	**1,674**	**1,725**	**1,917**	**2,082**	**2,227**	**2,368**	**2,560**	**2,685**	**2,752**	**2,787**	**67.7**
WESTERN EUROPE												
France	278	270	259	278	286	282	274	259	243	216	208	-25.4
Italy	541	514	612	455	486	474	404	455	498	435	459	-15.2
Netherlands	2,481	2,693	2,885	2,873	2,630	2,775	2,701	2,650	2,285	2,395	2,411	-2.8
Norway	—	8	12	110	557	815	984	988	956	956	1,031	—
United Kingdom	1,200	1,250	1,321	1,380	1,321	1,341	1,254	1,250	1,196	1,200	1,235	2.9
West Germany	592	537	553	564	604	604	553	564	494	514	514	-13.2
Others	133	145	141	153	157	153	137	118	118	114	114	-14.7
Total Western Europe	**5,225**	**5,417**	**5,782**	**5,813**	**6,041**	**6,444**	**6,307**	**6,234**	**5,790**	**5,829**	**5,970**	**14.3**
MIDDLE EAST												
Abu Dhabi	43	39	47	114	176	220	204	212	216	220	227	427.3
Iran	788	772	760	741	686	706	294	255	255	333	294	-62.7
Kuwait	188	184	196	212	220	306	243	188	165	180	192	2.1
Saudi Arabia	220	200	239	282	333	412	517	517	514	451	416	89.3
Others	184	243	235	243	247	380	388	329	333	325	376	104.3
Total Middle East	**1,423**	**1,439**	**1,478**	**1,592**	**1,662**	**2,023**	**1,646**	**1,501**	**1,482**	**1,509**	**1,505**	**5.8**
AFRICA												
Algeria	200	337	349	306	490	917	757	866	902	808	717	258.8
Libya	98	122	133	137	180	239	184	141	141	118	125	28.0
Nigeria	16	16	24	20	12	47	39	63	43	51	59	275.0
Others	35	24	31	39	47	63	71	71	110	125	141	300.0
Total Africa	**349**	**498**	**537**	**502**	**729**	**1,266**	**1,051**	**1,141**	**1,196**	**1,102**	**1,043**	**198.9**
ASIA AND AUSTRALASIA												
Japan	102	86	86	98	94	86	78	86	63	55	55	-46.2
Indonesia	192	82	82	200	384	557	655	678	686	580	643	234.7
Other Southeast Asia	251	290	388	404	392	392	419	427	427	412	431	71.9
Pakistan	176	165	184	208	208	200	243	239	310	337	474	168.9
Other South Asia	172	180	180	204	204	196	220	259	357	404	435	152.3
Australasia*	204	216	274	329	349	384	427	466	494	533	627	207.7
Total Asia and Australasia	**1,098**	**1,019**	**1,196**	**1,443**	**1,631**	**1,815**	**2,042**	**2,156**	**2,336**	**2,321**	**2,666**	**142.9**
Total Non-Communist World	**33,128**	**31,983**	**32,532**	**33,281**	**34,010**	**36,382**	**35,527**	**35,464**	**33,853**	**31,999**	**33,751**	**1.9**
COMMUNIST												
China	310	349	392	423	486	490	478	455	392	423	451	45.6
USSR	9,200	10,208	11,337	12,219	12,713	13,861	14,904	16,143	17,691	18,910	20,639	124.3
Others	1,654	1,831	1,831	1,835	1,889	1,811	1,772	1,815	1,823	1,772	1,780	7.6
Total Communist	**11,164**	**12,387**	**13,559**	**14,477**	**15,088**	**16,162**	**17,154**	**18,412**	**19,906**	**21,105**	**22,869**	**104.8**
Total World	**44,292**	**44,370**	**46,091**	**47,757**	**49,098**	**52,544**	**52,681**	**53,876**	**53,759**	**53,104**	**56,620**	**27.8**

*Includes Australia, New Zealand, Papua New Guinea, South West Pacific Islands

Source: British Petroleum

World crude oil prices

Official Sales and Term Contracts
(Dollars per barrel)
(1 January)

Year	Total World	Total OPEC	Total Non-OPEC	Difference OPEC-NonOPEC
1975-1978 — Not Available				
1979	13.08	13.03	13.44	+0.41
1980	28.84	28.30	31.94	+3.64
1981	35.49	34.82	38.54	+3.72
1982	34.18	34.13	34.35	+0.22
1983	33.00	33.54	31.72	-1.82
1984	28.61	28.59	28.65	+0.06
1985	28.33	28.43	28.16	-0.27
CHANGE 1981 to 1985				
Actual	-7.16	-6.39	-10.38	
Percentage	-20.2%	-18.4%	-26.9%	

Source: DOE

Price–Arabian Light Crude

Year	Average government selling price	Average spot market price	Difference
	— (U.S. dollars per barrel) —		
1975	10.72	10.70	- 0.02
1976	11.51	11.63	+ 0.12
1977	12.40	12.43	+ 0.03
1978	12.70	13.00	+ 0.30
1979	17.26	29.89	+12.63
1980	28.67	35.69	+ 7.02
1981	32.50	34.30	+ 1.80
1982	34.00	31.76	- 2.24
1983	29.50	28.80	- 0.70
1984e	29.00	27.80	- 1.20
1985-(Feb)	28.00	27.65	- 0.35

Note: Government selling price—moved up $23.28 per barrel (217.2%) from 1976 to peak in 1982. Has fallen $6.00 per barrell (17.6%) since peak. Spot market price—moved up $24.99 per barrell (233.6%) from 1976 to peak in 1980. Has fallen $8.04 per barrel (22.5%) since peak.

Source: DOE and Shell Oil

OECD* petroleum stocks (million barrels)

	1977	1978	1979	1980	1981	1982	1983	1984	— 1980/1977 — Change	% change	— 1984/1980 — Change	% change
Canada	167	144	150	164	161	136	120	115	- 3	- 1.8	- 49	-29.9
France	239	201	226	243	214	193	153	130†	+ 4	+ 1.7	-113	-46.5
Italy	161	154	163	170	167	179	149	157	+ 9	+ 5.6	- 13	- 7.6
Japan	409	413	460	495	482	468	471	468	+ 86	+21.0	- 27	- 5.5
United Kingdom	148	157	169	168	143	125	119	117	+ 20	+13.5	- 51	-30.4
United States	1,312	1,278	1,341	1,392	1,484	1,430	1,454	1,499†	+ 80	+ 6.1	107	7.7
West Germany	225	238	272	319	297	272	250	248	+ 94	+41.8	- 71	-22.3
Other OECD	524	512	594	636	583	557	542	510†	+112	+21.4	-126	-19.8
Total OECD	**3,185**	**3,097**	**3,375**	**3,587**	**3,531**	**3,360**	**3,258**	**3,244†**	**+402**	**+12.6**	**-343**	**- 9.6**

*Organization of Economic Cooperation & Development. †Estimate

Source: Energy Information Administration

The excess capacity headache will remain and prices will continue to be soft for the forseeable future. Only OPEC's ability to maintain production quotas will prevent the price from collapsing.

Although official prices may not be altered much, spot market transactions, barter deals and direct country to country sales will reduce the actual transaction price.

The search for oil throughout the world has not dropped substantially. The international oil companies have found that there is substantially more profit margin in equity crude than in crude purchased from OPEC exporters.

The number of active drilling rigs outside the U.S. and Canada peaked in 1982 at 1,477. The active rig count fell to 1,311 in 1973 and 1,237 in 1984. This is a drop of 16.2% from the peak but still higher than the years prior to 1980. The most activity in 1984 was in Latin America where there were 438 active rigs. There were 258 active rigs in the Far East, 204 in Western Europe, 195 in the Middle East and 105 in Africa.

One of the major reasons for the high level of activity in the face of declining demand is the still relatively high price of oil. Sine the price of oil far surpassed the general rate of inflation over the past decade, the profit margin has increased considerably. Previously uneconomic or marginal fields are now being developed throughout the world. And huge import bills have encouraged countries without sufficient production to stimulate exploration activities.

Looking to the future, as oil becomes more difficult to find, particularly in large quantities, activity must increase in order to maintain reserves.

The result of this active search has been the maintenance of worldwide reserves. Total world reserves moved up to 698.7 billion barrels as of the first of 1985. Compared to 10 years earlier, reserves were down only 17 billion barrels, a drop of 2.4%. OPEC reserves represented 68.2% of total world reserves at 476.4 billion barrels. OPEC reserves were down only 1.8% from 1975. Worldwide reserves have been replaced throughout a period of peak consumption. This is attributable to the increased value of the oil and the increased exploration activity.

The reserves production ratio was 35.2 years in 1975. This fell 26.7 years in 1979, the year of peak production. In 1984 the ratio moved up to 31.7 years. It is estimated at 32.8 years in 1985.

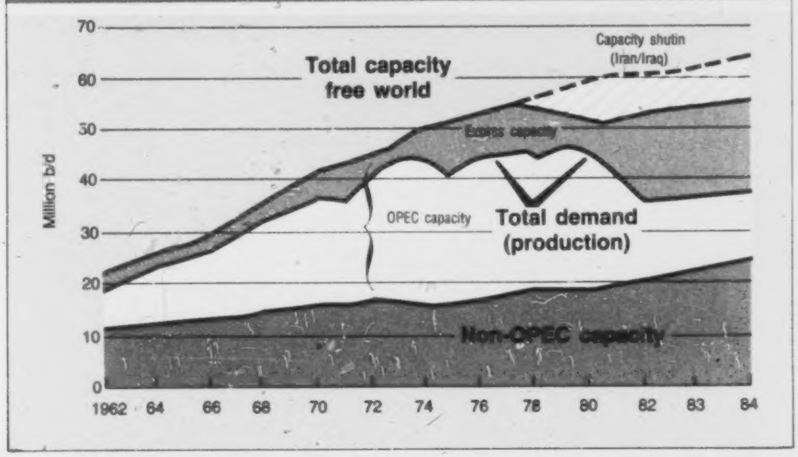
The reserves production ratio has been maintained and there is no apparent immediate pressure on oil availability. However, it is evident from the reserves profile that OPEC still holds the key position in future world supply.

Investments in exploration and production must be maintained if the reserves to production ratio is to be sustained. And unless activity is sustained the OPEC influence over prices will be reinstated in the near future.

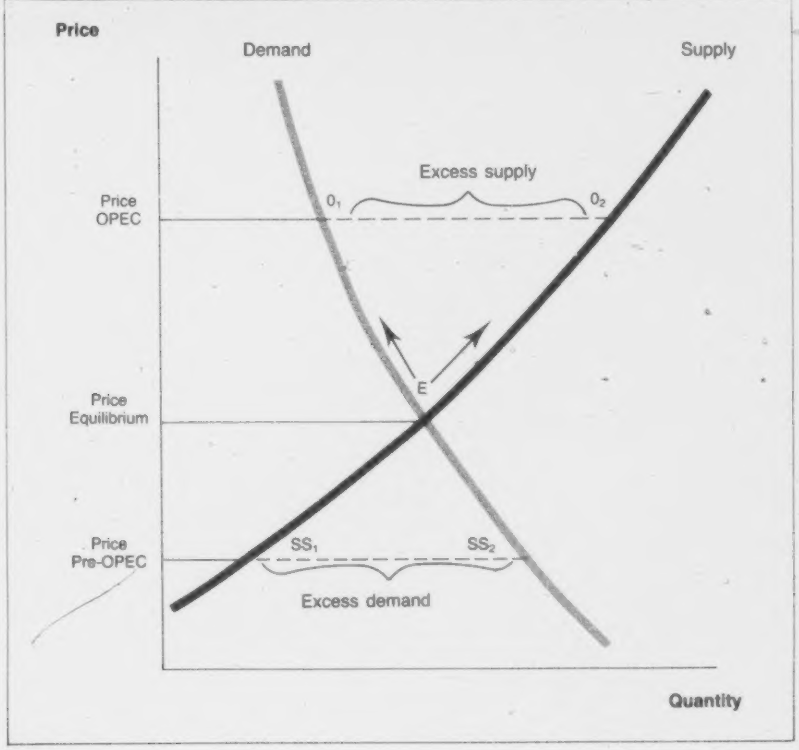
The number of active drilling rigs outside the U.S. and Canada is expected to move up continuously throughout the forecast period. The rig count will move up to 1450 in 1990.

The production estimates for 1985–1990 are based upon normal expectations. However a political upheaval could have some impact on worldwide supply. Of most concern is the closing of the Strait of Hormuz due to action in the Iran-Iraq war. At the present time about 6.4 million b/d is being exported via the Strait of Hormuz. The free world total imports are somewhere close to 25.5 million b/d. Therefore, 26% of total free world import requirements would be

Free world crude capacity



Theoretical supply and demand for world oil



The Strait of Hormuz—1984

Country	Crude oil production 1,000 b/d
Iran	2,174
Kuwait	937
Saudi Arabia	4,464
Qatar	396
United Arab Emirates	1,159
Total	**9,130**
Free world production	39,262
% of free world production	23.3
Exports via strait of Hormuz	6,440
Free world crude imports	19,435
% of free world crude imports	33.1
Free world crude & product imports	25,135
% of free world crude & product imports	25.6

Source: Authors estimates

eliminated if the strait was closed. It is estimated that 3 million b/d could be made up by increasing production in other countries with surplus capacity and by diverting some of the Saudi Arabian export stream via the pipeline to the Red Sea.

If the remaining OPEC countries did not increase production sufficiently to cover the 3–4 million b/d shortfall, prices could move up sharply. But the impact on prices would be dependent upon what action was taken to reopen the strait.

If it appeared that the closing was only temporary the industrial countries and international oil companies might simply draw down stock levels to meet the demand.

The potential impact has been sharply reduced along with the reduction in dependency upon imports through the Strait of Hormuz. Two years ago 8.4 million b/d, 36% of free world imports, were coming through the Strait.

To get a better perspective on what has been happening in the world oil industry and world oil prices, it might be advantageous to take a look from the viewpoint of classical economic theory.

In classical theory, price is the determinant of supply and demand. When external forces create a situation where there is not equilibrium, i.e., demand and supply do not meet at a market clearing price, then there are economic forces at work attempting to move the market toward equilibrium.

Prior to the establishment of OPEC, there is some justification in assuming that the international oil companies held the price below the equilibrium price. This created a situation of excess demand. The oil companies met demand by concentrating on production and pricing with respect to current production costs. Little emphasis was given to the long run value of reserves in the ground. The result was a rapid increase in demand as cheap oil energy fueled economic expansion worldwide.

When OPEC gained control over production, they placed more emphasis on the long term value and life of their oil reserves. They attempted to maximize immediate return rather than output. And they were reaching for the price level the market would bear. To a certain extent OPEC was using the world as a large economic laboratory to test the elasticity of demand for crude oil. The result of OPEC's pricing policy was reduced demand and increased supply netting out to an excess supply situation.

However, market forces are beginning to take hold, and there is movement toward equilibrium. This is taking the form of falling prices, increasing demand, and a reduction in supply.

The official posted price of the OPEC marker crude, Saudi Arabian light, was first boosted 294.2% from $2.75/bbl in 1973 to $10.84/bbl in 1974. The price moved up slowly to $12.70/bbl in 1978, an additional increase of 17.2%. Because of the sharp increase in the rate of inflation over this period, the real price actually fell during this period. Demand for crude oil continued to move up even though the actual price had increased substantially.

OPEC therefore raised prices again, sharply, from $12.70/bbl in 1978 to $34.00/bbl at end 1981, an additional increase of 167.7%. The overall price increase from 1973 through 1981 was +$31.25/bbl, up 1136.4%.

Demand began to react to the huge price increases. Conservation, fuel switching, and a slow down in economic activity led to a 12.5% drop in free world demand between 1979 and 1983. The drop in demand coupled with the increase in non-OPEC production resulted

World oil refinery throughputs

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	% change 83/73	% change 83/79
						1,000 b/d							
USA	12,555	12,280	12,475	13,435	14,625	14,780	14,465	13,520	12,470	11,775	11,215	−10.7	−22.5
Canada	1,675	1,765	1,700	1,710	1,805	1,820	1,960	2,085	1,945	1,650	1,570	− 6.3	−19.9
Latin America	5,970	5,890	5,515	5,670	5,715	5,975	6,220	6,460	6,575	6,080	5,825	− 2.4	− 6.4
Western Europe	15,065	14,175	12,415	13,625	13,550	13,505	14,160	12,925	11,890	11,480	11,075	−26.5	−21.8
Middle East	2,170	2,330	2,075	2,300	2,240	2,535	2,365	2,445	2,205	2,245	2,515	15.9	6.3
Africa	930	930	1,005	1,055	1,165	1,280	1,355	1,460	1,525	1,735	1,920	106.5	41.7
Japan	4,430	4,300	4,055	4,230	4,285	4,240	4,340	4,015	3,630	3,360	3,240	−26.9	−25.3
Southeast Asia	1,705	1,560	1,545	1,865	2,030	2,330	2,450	2,370	2,480	2,335	2,335	37.0	− 4.7
South Asia	590	550	485	550	605	645	675	705	795	840	880	49.2	30.4
Australasia*	620	625	635	655	680	690	700	640	655	625	600	− 3.2	−14.3
Total Non-Communist	**45,710**	**44,405**	**41,905**	**45,095**	**46,700**	**47,800**	**48,690**	**46,625**	**44,170**	**42,125**	**41,175**	**− 9.9**	**−15.4**
Communist	9,365	10,185	11,025	11,575	11,930	12,875	13,230	13,320	13,420	13,575	13,675	46.0	3.4
Total World	**55,075**	**54,590**	**52,930**	**56,670**	**58,630**	**60,675**	**61,920**	**59,945**	**57,590**	**55,700**	**54,850**	**− 0.4**	**−11.4**

*Includes Australia, New Zealand, Papua New Guinea, South West Pacific Islands.

Source: British Petroleum

World oil refining capacities

Country/Area	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	% change 84/74	% change 84/81
						1,000 b/d							
NORTH AMERICA													
USA	14,960	15,235	16,400	16,945	17,375	17,920	18,250	18,290	16,860	15,865	15,135	1.2	−17.2
Canada	2,010	2,080	2,195	2,220	2,340	2,315	2,150	2,155	2,260	2,025	2,015	0.2	− 6.5
Total North America	**16,970**	**17,315**	**18,595**	**19,165**	**19,715**	**20,235**	**20,400**	**20,445**	**19,120**	**17,890**	**17,150**	**1.1**	**−16.1**
LATIN AMERICA													
Argentina	700	700	700	660	660	660	690	690	690	690	690	− 1.4	—
Brazil	1,020	1,020	1,020	1,175	1,230	1,230	1,375	1,530	1,530	1,400	1,305	27.9	−14.7
Mexico	735	785	905	980	1,525	1,395	1,395	1,525	1,525	1,525	1,525	107.5	—
Netherlands Antilles	810	810	810	840	840	840	840	780	780	780	740	− 8.6	—
Trinidad	460	460	460	465	465	465	455	455	375	375	320	−30.4	−29.7
Venezuela	1,475	1,445	1,445	1,445	1,445	1,445	1,425	1,405	1,360	1,225	1,225	−16.9	−12.8
Others	2,180	2,180	2,365	2,480	2,545	2,645	2,580	2,515	2,380	2,205	2,135	− 2.1	−15.1
Total Latin America	**7,380**	**7,400**	**7,705**	**8,045**	**8,710**	**8,680**	**8,760**	**8,900**	**8,640**	**8,200**	**7,940**	**7.6**	**−10.8**
WESTERN EUROPE													
Belgium	935	975	1,080	1,055	1,030	1,020	1,020	965	720	720	715	−23.5	−25.9
France	3,305	3,320	3,495	3,465	3,445	3,420	3,320	3,230	2,745	2,365	2,190	−33.7	−32.2
Italy	3,890	4,345	4,345	4,270	4,205	4,205	4,140	3,990	3,500	3,365	2,745	−29.4	−31.2
Netherlands	1,950	1,950	1,950	1,835	1,815	1,815	1,775	1,775	1,590	1,610	1,500	−23.1	−15.5
Spain	995	1,180	1,275	1,210	1,375	1,475	1,425	1,550	1,550	1,440	1,440	44.7	− 7.1
United Kingdom	2,960	2,950	2,875	2,655	2,515	2,460	2,460	2,360	2,135	2,105	1,980	−33.1	−16.1
West Germany	2,980	3,115	3,110	3,065	3,090	3,040	3,095	2,955	2,520	2,280	2,105	−29.4	−28.8
Others	2,240	2,810	2,880	2,925	3,290	3,080	3,230	3,175	3,335	3,135	3,140	40.2	− 1.1
Total Western Europe	**19,255**	**20,645**	**21,010**	**20,480**	**20,765**	**20,515**	**20,465**	**20,000**	**18,095**	**17,025**	**15,815**	**−17.9**	**−20.9**
MIDDLE EAST													
Bahrain	250	250	250	250	250	250	250	250	250	250	250	—	—
Iran	665	715	715	965	1,045	1,045	1,225	625	625	600	530	−20.3	−15.2
Iraq	185	185	185	185	230	265	265	265	265	200	300	62.2	13.2
Kuwait	525	565	575	575	575	575	575	530	545	590	590	12.4	11.3
Saudi Arabia	465	465	630	630	635	635	495	660	865	865	865	86.0	31.1
Others	575	570	595	640	640	770	755	920	1,015	1,055	1,095	90.4	19.0
Total Middle East	**2,665**	**2,750**	**2,950**	**3,245**	**3,375**	**3,540**	**3,565**	**3,250**	**3,565**	**3,560**	**3,630**	**36.2**	**11.7**
Africa	1,240	1,270	1,380	1,505	1,730	2,000	2,060	2,035	2,355	2,340	2,535	104.4	24.6
ASIA AND AUSTRALASIA													
Japan	5,040	5,215	5,285	5,285	5,285	5,285	5,675	5,675	5,500	4,975	4,975	− 1.3	−12.3
Indonesia	415	415	525	525	535	535	515	515	515	760	905	118.1	75.7
Singapore	1,040	1,040	1,040	1,040	1,040	1,040	1,020	1,020	1,020	1,020	1,020	− 1.9	—
Other Southeast Asia	1,210	1,270	1,270	1,570	1,650	1,810	1,890	1,940	1,940	1,940	1,955	61.6	—
South Asia	725	735	735	785	825	825	870	885	995	1,020	1,020	40.7	15.3
Australasia*	745	760	760	760	785	800	810	815	815	815	815	9.4	0.0
Total Asia and Australasia	**9,175**	**9,435**	**9,615**	**9,965**	**10,120**	**10,295**	**10,780**	**10,850**	**10,785**	**10,530**	**10,690**	**16.5**	**− 1.5**
Total Non-Communist World	**56,685**	**58,815**	**61,255**	**62,405**	**64,415**	**65,265**	**66,030**	**65,480**	**62,560**	**59,545**	**57,760**	**1.9**	**−11.8**
COMMUNIST													
China	1,155	1,250	1,500	1,600	1,800	1,900	1,900	1,810	2,000	2,050	2,150	86.1	18.8
U.S.S.R.	8,360	9,060	9,400	9,600	10,000	10,500	10,700	11,600	11,750	12,000	12,000	43.5	3.4
Others	1,940	2,080	2,240	2,280	2,360	2,410	2,500	2,780	2,780	2,780	2,780	43.3	—
Total Communist	**11,455**	**12,390**	**13,140**	**13,480**	**14,160**	**14,810**	**15,100**	**16,190**	**16,530**	**16,830**	**16,930**	**47.8**	**4.6**
Total World	**68,140**	**71,205**	**74,395**	**75,885**	**78,575**	**80,075**	**81,130**	**81,670**	**79,090**	**76,375**	**74,690**	**9.6**	**− 8.5**

*Includes Australia, New Zealand, Papua New Guinea, and South West Pacific Islands.

Source: British Petroleum

in the massive excess capacity.

And this excess capacity put substantial downward pressure on prices. The official OPEC merker crude price fell to $28/bbl early in 1985, a reduction of 17.6%, from the peak $34 level. The average spot market price fell from $35.69/bbl for 1980 to an estimated $27.80/bbl in 1984, a drop of 22.1%. Free world demand responded to this sharp drop in prices and moved up 2.1% in 1984.

The growth in excess capacity has led to a shift in trading from contract to the spot market. When prices moved up sharply in 1979–1981 spot market prices were well above official prices. The average spot market price in 1979 was $12.60/bbl higher than the contract price. This undoubtedly prompted OPEC to push up the official price. With the development of the excess capacity, spot market prices fell below official prices and have led to the drop in official prices. The volume of crude traded in the spot–market has grown substantially over the past few years. In fact, at the present time the vast majority of transactions are spot market transactions or contract trades based on spot market prices. In addition, because of the more speculative nature of crude trading and prices today a futures market has developed and is growing rapidly. In two years the number of contracts traded on the New York Mercantile Exchange has taken off with 350 million bbl in 1983 and 1850 million bbl in 1984.

In an attempt to prevent a collapse of prices OPEC has established production quotas for each member country. OPEC set a production quota in 1983 of 17.5 million b/d. However prices continued to slide and the production quota was reduced to 16 million b/d in 1984. There has been considerable cheating with a number of OPEC countries producing above their quota. However, the attempt to control production has reduced total output and prevented a free fall in prices.

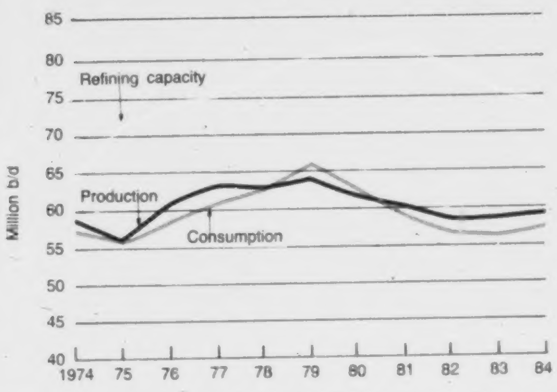
It is estimated that prices will continue to fall through 1988. OPEC has tried to prevent overproduction of quotas by establishing an independent auditing agency. But in addition to overproduction, a number of OPEC countries are entering into barter deals that they are not counting in official production estimates. This has all helped to boost the quantity of crude oil available on the market and kept the downward pressure on prices.

By 1988 the inflation adjusted real price of oil is expected to be at a level comparable to the real price in 1979 when demand was still on the rise. By that time demand will begin to move up boosted by the lower real price of crude.

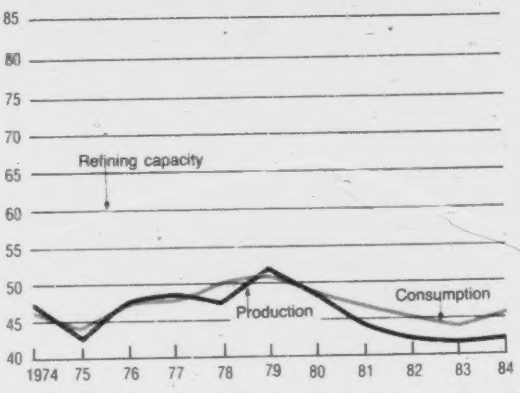
With the drop in demand for petroleum products, crude runs through refineries also fell sharply. And as refinery runs fell excess capacity developed in the refining industry. Refining capacity represents a substantial fixed investment in plant and equipment. And therefore capacity adjustment to the declining demand was a slow process.

There was an initial delay as refineries attempted to determine if the peaking of demand and subsequent decline was a temporary phenomenon, or if it was a permanent demand adjustment that would require adjustment in refining capacity. Based on the long term forecasts that projected steadily increasing long term demand, refineries initially adjusted by running at a lower utilization rate. As it became apparent that the downturn in demand was signaling a much lower long term level of demand, refineries realized that the industry was faced with a massive excess capacity. Utilization rates

World
Output, use, refining capacity



Non-Communist World
Output, use, refining capacity



Free world active rig count

	Annual Average																
	1976	1977	1978	1979	1980	1981			1982			1983			1984		
Region	**Total**	**Total**	**Total**	**Total**	**Total**	**Land**	**Off.**	**Total**	**Land**	**Off.**	**Total**	**Land**	**Off.**	**Total**	**Land**	**Off.**	**Total**
Canada	179	218	272	339	401	259	5	264	195	5	200	190	11	201	245	14	259
United States	1,656	2,001	2,255	2,176	2,910	3,715	255	3,970	2,861	244	3,105	2,030	199	2,229	2,216	213	2,429
North America	**1,835**	**2,219**	**2,527**	**2,515**	**3,312**	**3,973**	**260**	**4,233**	**3,056**	**249**	**3,305**	**2,220**	**210**	**2,430**	**2,461**	**227**	**2,688**
Argentina	65	68	72	63	76	67	3	70	65	2	67	72	1	73	82	0	82
Brazil	44	45	52	60	72	52	30	82	63	31	94	54	29	83	44	25	69
Mexico	138	148	167	205	215	198	20	218	180	22	202	160	27	187	166	30	196
Venezuela	16	20	33	47	52	46	17	63	52	18	70	29	12	41	21	9	30
Others	55	54	56	65	65	73	15	88	74	14	88	53	14	67	48	13	61
Latin America	**318**	**335**	**380**	**440**	**480**	**436**	**85**	**521**	**434**	**87**	**521**	**368**	**83**	**451**	**361**	**77**	**438**
India	41	43	40	40	43	37	7	44	41	10	51	41	14	55	40	17	57
Indonesia	51	46	62	66	77	60	27	87	60	32	92	62	25	87	56	26	82
Others	72	70	77	111	120	87	40	127	92	42	134	96	38	134	83	36	119
Far East	**164**	**159**	**179**	**217**	**240**	**184**	**74**	**258**	**193**	**84**	**277**	**199**	**77**	**276**	**179**	**79**	**258**
Algeria	83	108	101	109	111	91	0	91	81	0	81	53	0	53	27	0	27
Libya	19	23	28	33	41	31	2	33	29	2	31	22	2	24	24	2	26
Nigeria	15	16	16	18	20	16	6	22	16	11	27	9	8	17	5	6	11
Others	21	26	30	40	47	29	37	66	29	41	70	26	37	63	16	25	41
Africa	**138**	**173**	**175**	**200**	**219**	**167**	**45**	**212**	**155**	**54**	**209**	**110**	**47**	**157**	**72**	**33**	**105**
Germany-West	22	21	22	21	22	25	1	26	31	0	31	25	0	25	19	0	19
Italy	11	12	18	21	19	24	7	31	31	7	38	19	7	26	20	6	26
United Kingdom	36	36	34	34	48	5	53	58	2	55	57	2	40	42	6	54	60
Others	74	71	68	76	89	72	29	101	73	36	109	60	33	93	66	33	99
Western Europe	**143**	**140**	**142**	**152**	**178**	**126**	**90**	**216**	**137**	**98**	**235**	**106**	**80**	**186**	**111**	**93**	**204**
Abu Dhabi	14	15	16	20	23	13	17	30	18	23	41	12	23	35	9	20	29
Egypt	22	20	16	21	26	10	16	26	14	22	36	16	19	35	15	21	36
Saudi Arabia	16	21	22	22	25	16	13	29	16	14	30	14	12	26	10	6	16
Turkey	17	16	17	9	24	26	0	26	34	0	34	26	0	26	24	0	24
Others	121	120	118	71	77	52	7	59	52	7	59	75	13	88	83	7	90
Middle East	**190**	**192**	**189**	**143**	**175**	**117**	**53**	**170**	**134**	**66**	**200**	**143**	**67**	**210**	**141**	**54**	**195**
Australia	6	7	[illegible]	11	15	18	5	23	24	9	33	15	10	25	24	10	34
Others	2	1		2	3	2	1	3	2	0	2	3	3	6	2	1	3
South Pacific	**8**	**8**		**13**	**18**	**20**	**6**	**26**	**26**	**9**	**35**	**18**	**13**	**31**	**26**	**11**	**37**
Total Free World	**2,796**	**3,226**	**3,604**	**3,680**	**4,622**	**5,023**	**613**	**5,636**	**4,135**	**647**	**4,782**	**3,164**	**577**	**3,741**	**3,351**	**574**	**3,925**
Total excl. North America	**961**	**1,007**	**1,077**	**1,165**	**1,310**	**1,050**	**353**	**1,403**	**1,079**	**398**	**1,477**	**944**	**367**	**1,311**	**890**	**347**	**1,237**

Source: Hughes Tool Co

for the free world dropped to 67.3% in 1982, from a rate of 74.6% in 1979. The rate moved up to 73.7% in 1984, as demand increased and capacity was reduced.

Faced with sharply reduced, and in many cases, negative refining margins, refiners have started to adjust capacity by mothballing or permanently closing facilities. This process will undoubtedly continue until refining margins are restored to an acceptable level. Another threat to profitability is emerging, the increase in OPEC refining capacity. It is apparent that OPEC countries intend to carve out a portion of the refined products market.

OPEC has plans to increase their refining capacity substantially. Plans are being reviewed but they had planned to boost capacity about 50% to 8.5 million b/d. OPEC will not only be supplying a much greater percentage of their own internal petroleum product requirements but will also be expanding their role in the product export market.

This may really be one of the major issues of concern to the world oil industry in the late 1980's. The major international oil companies have lost control over a substantial portion of world crude production. And now they will be meeting competition from OPEC in refining. This is probably also of concern to the major industrial countries. A great deal of revenue is derived from taxes on refined products. If OPEC is able to capture a portion of the refined product market, they may capture the revenue now collected as taxes by the industrial countries or substantially drive up the price of refined products.

Free world refining capacity peaked in 1980 at 66.03 million b/d and remained relatively high in 1981 at 65.48 million b/d. Capacity has now fallen 12.5% to 57.76 million b/d in 1984. Refiners started reducing capacity at a more rapid rate once they realized that demand was not going to rebound to previous levels.

World refining capacity is expected to continue to decline until 1987 and then level off. Crude runs are expected to follow demand and move up throughout the forecast period. As a result the refinery utilization rate will increase throughout the 1985–1990 period.

The reluctance of refiners to adjust runs immediately to the initial drop in demand coupled with a reluctance to break long-term contractural agreements for crude from export nations resulted in a huge buildup of stocks in 1980 and 1981. Stocks for the OECD group of countries increased 402 million bbl from 1977 to 1980 and peaked at 3,587 million bbl.

Refiners originally defended the high stock levels as a buffer against a potential supply disruption and a rebound in demand. But the acceleration in worldwide inflation brought high interest rates that translated into very high carrying costs for the excessive inventories. Refiners found it difficult to reduce stocks in the face of falling demand. But they made a concentrated effort in breaking long-term crude supply agreements and forcing stocks back into the ground by reducing offtakes. From 1980 to 1984, stocks of the OECD countries fell 343 million bbl. Stocks fell 171 million bbl in 1982, alone contributing almost 500,000 b/d to the supply of crude and reducing import demand.

As a portion of demand was supplied directly from inventory, production and export levels fell at a faster rate than product demand. It is now felt refiners have reached an acceptable balance between demand and stocks and that the inventory drawdown has stopped. Any increase in demand will be met by new production rather than a

Middle East crude oil refining capacity

(1,000 b/d)

Country	As of January 1 1974	1984	Change Barrels	%
Bahrain	265	265	—	—
Egypt	180	400	220	122
Iran	665	585	(80)	(12)
Iraq	185	545	360	195
Kuwait*	535	635	100	19
Oman	—	50	50	—
Qatar	1	60	59	—
Saudi Arabia*	665	875	210	32
United Arab Emirates	—	180	180	NMF
Total	**2,496**	**3,595**	**1,099**	**44**

*Includes one-half of Neutral Zone.

Source: Exxon Corp. estimates.

Worldwide excess productive capacity

	Production			Productive capacity*			Excess capacity				
										% of	
	OPEC	Non-OPEC	Total Non-Comm	OPEC	Non-OPEC	Total Non-Comm	OPEC	Non-OPEC	Total Non-Comm	Total capacity	Total production
	(Thousand b/d)										
1960			17,668			19,100			1,432	7.50	8.11
1961	9,364	9,319	18,683	10,150	10,050	20,200	786	731	1,517	7.51	8.12
1962	10,508	9,663	20,171	11,350	10,450	21,800	842	787	1,629	7.47	8.08
1963	11,514	10,036	21,550	12,450	10,850	23,300	936	814	1,750	7.51	8.12
1964	12,984	10,206	23,190	14,050	11,050	25,100	1,066	844	1,910	7.61	8.24
1965	14,339	10,552	24,891	15,500	11,400	26,900	1,161	848	2,009	7.47	8.07
1966	15,770	11,235	27,005	17,050	12,150	29,200	1,280	915	2,195	7.52	8.13
1967	16,850	12,155	29,005	18,200	13,150	31,350	1,350	995	2,345	7.48	8.08
1968	18,786	13,114	31,900	20,300	14,200	34,500	1,514	1,086	2,600	7.54	8.15
1969	20,907	13,569	34,476	22,600	14,650	37,250	1,693	1,081	2,774	7.45	8.05
1970	23,413	14,515	37,928	25,300	15,700	41,000	1,887	1,185	3,072	7.49	8.10
1971	25,326	14,575	39,901	27,400	15,750	43,150	2,074	1,175	3,249	7.53	8.14
1972	27,094	14,845	41,939	29,300	16,050	45,350	2,206	1,205	3,411	7.52	8.13
1973	30,989	14,942	45,931	33,500	16,150	49,650	2,511	1,208	3,719	7.49	8.10
1974	30,729	14,593	45,322	34,800	15,750	50,550	4,071	1,157	5,228	10.34	11.54
1975	27,155	14,418	41,573	36,100	15,600	51,700	8,945	1,182	10,127	19.59	24.36
1976	30,738	14,548	45,287	37,400	15,750	53,150	6,662	1,202	7,863	14.79	17.36
1977	31,278	15,595	46,873	38,700	16,850	55,550	7,422	1,255	8,677	15.62	18.51
1978	29,805	17,304	47,109	36,480	18,700	55,180	6,675	1,396	8,071	14.63	17.13
1979	30,928	17,708	48,636	34,260	19,150	53,410	3,332	1,442	4,774	8.94	9.82
1980	26,890	18,316	45,200	32,730	19,800	52,530	5,840	1,484	7,330	13.95	16.22
1981	22,624	18,853	41,477	31,200	20,400	51,600	8,576	1,547	10,123	19.62	24.41
1982	18,584	19,768	38,352	31,200	21,400	52,600	12,616	1,632	14,248	27.09	37.15
1983	17,317	20,718	38,035	31,200	22,400	53,600	13,883	1,682	15,565	29.00	40.90
1984	17,434	21,828	39,262	31,000	23,600	54,600	13,566	1,772	15,338	28.10	39.10

*Estimated

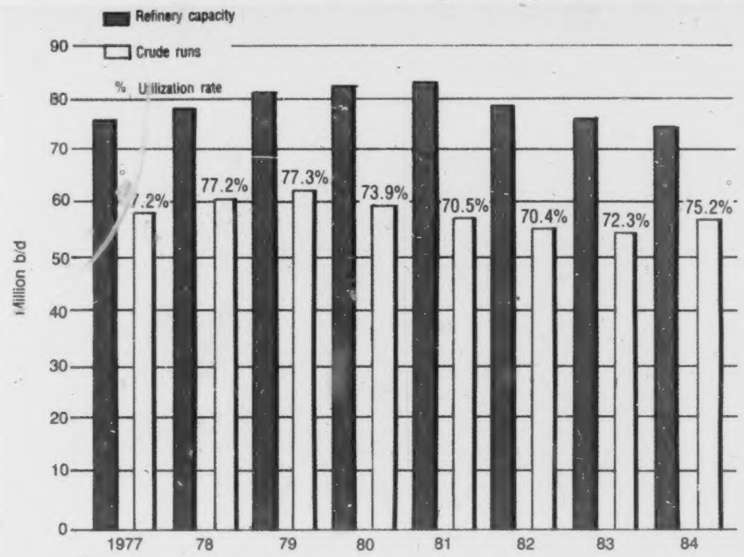
World export crude oil prices

Official Sales and Term Contract Prices (Dollars per barrel - 1 January)

Year	Saudi Arabia Arabian Light 34°	Nigeria Bonny Light 37°	United Kingdom Brent 38°	Mexico Isthmus 33°	U.S.S.R. Export Blend 32°
1979	12.70	15.12	—	13.10	13.20
1980	26.00	29.97	26.02	32.00	33.20
1981	32.00	40.00	39.25	38.50	39.25
1982	34.00	36.50	36.60	35.00	35.49
1983	34.00	35.50	33.50	32.50	31.20
1984	29.00	30.00	30.00	29.00	28.60
1985	29.00	28.00	28.65	29.00	28.00
Feb. 1985 OPEC price	28.00	28.65	—	—	—
Feb. 1985 Spot price	27.65	27.20	28.05	—	—

Source: DOE and Author's estimates.

Total world refining capacity and crude runs



	1977	78	79	80	81	82	83	84
Refinery capacity	75.9	78.6	80.1	81.1	81.7	79.1	76.4	74.7
Crude runs	58.6	60.7	61.9	59.9	57.6	55.7	55.2	56.2

Source: British Petroleum

reduction in stocks. With demand expected to move upward throughout the forecast period stocks will probably increase slightly as a balance is retained in terms of days of supply. But there may be some temporary stock reductions as refiners try to take advantage of falling crude oil prices.

Worldwide natural gas production has been increasing steadily over the past 10 years increasing 27.8% from 44.3 trillion cu ft in 1974 to 56.6 trillion cu ft in 1984. The natural gas share of total primary energy consumption has moved up from 18.6% in 1972 to 19.6% in 1984. The natural gas share of total energy market will probably increase over the forecast period and therefore gas production will continue to climb.

Over the 1974-1984 period the area posting the largest increase has been the Communist block, primarily due to increased production in the U.S.S.R. Production from the Communist countries increased 104.8%, up 11.7 billion cu ft. Production in the U.S.S.R. increased 11.4 billion cu ft over the same period, up 27.8%. This sharp increase enabled the U.S.S.R. to launch their massive natural gas export project; exporting gas to Western Europe.

Production in the non communist countries increased only 1.9% over the ten year span. North American production fell 15.4%. United States production fell 16.8% and Canadian production fell 3.8%.

A look at worldwide gas reserves indicates that there will be little geographical shift in production over the next few years. The huge reserves in the U.S.S.R, 41% of the world's total, means that they will be a major user and supplier of natural gas for many years to

Worldwide gas reserves

	Jan. 1 1973	1978	1983 (Billion cu ft)	1984	1985		Change 1985-1973		% change 1985 1973
Australia	36,236	32,000	17,768	17,682	17,850		18,386		50.7
India	2,300	3,500	14,508	14,826	15,000	+	12,700	+	552.2
Indonesia	5,500	24,000	29,600	30,200	40,000	+	34,500	+	627.3
Malaysia	*10,000	17,000	34,000	48,000	50,000	+	40,000	+	400.0
Pakistan	16,000	15,500	18,540	15,800	15,760		240		1.5
Thailand	—	4,500	11,000	8,500	5,900	+	5,900		—
Others	31,200	31,225	20,831	21,227	21,680		9,520		30.5
Total Asia-Pacific	**101,236**	**122,725**	**146,247**	**156,235**	**166,190**	**+**	**64,954**	**+**	**64.2**
Netherlands	88,000	60,000	51,920	50,050	68,482		19,518		22.2
Norway	15,000	20,000	58,000	58,800	89,000	+	74,000	+	493.3
United Kingdom	45,000	29,000	25,400	25,100	27,800		17,200		38.2
Others	30,400	29,190	21,416	23,378	21,391		9,009		29.6
Total Western Europe	**178,400**	**138,190**	**156,736**	**157,328**	**206,673**	**+**	**28,273**	**+**	**15.8**
Abu Dhabi	12,000	20,000	19,260	20,500	20,750	+	8,750	+	72.9
Iran	200,000	500,000	482,600	480,000	478,600	+	278,600	+	139.3
Iraq	25,000	28,000	28,800	29,000	28,800	+	3,800	+	15.2
Kuwait	33,000	31,500	29,900	31,000	32,500		500		1.5
Qatar	8,000	40,000	62,000	62,000	150,000	+	142,000	+	+1,775.0
Saudi Arabia	50,000	85,000	117,000	121,000	123,270	+	73,270	+	146.5
Others	16,150	15,160	30,170	31,547	35,435	+	19,285	+	119.4
Total Middle East	**344,150**	**719,660**	**769,730**	**775,047**	**869,355**	**+**	**525,205**	**+**	**152.6**
Algeria	105,000	125,000	111,250	110,180	109,100	-	4,100	-	3.9
Libya	27,500	25,700	21,500	21,350	21,200		6,300		22.9
Nigeria	40,000	43,000	32,400	34,800	35,600		4,400		11.0
Others	16,515	13,804	24,273	23,314	21,276	+	4,761	+	28.8
Total Africa	**189,015**	**207,504**	**189,423**	**189,644**	**187,176**	**–**	**1,839**	**–**	**1.0**
Argentina	8,800	8,120	25,200	24,420	24,628	+	15,828	+	179.9
Mexico	11,500	30,000	75,850	75,352	77,000	+	65,500	+	569.6
Trinidad & Tobago	7,500	8,500	11,000	13,100	10,550	+	3,050	+	40.7
Venezuela	34,600	41,000	54,079	54,546	55,367	+	20,767	+	60.0
United States	271,455	210,000	204,000	198,000	198,000		73,455		27.1
Canada	55,000	58,000	97,000	90,500	92,300	+	37,300	+	67.8
Others	16,818	20,960	20,462	18,978	17,386	-	568	-	3.4
Total Western Hemisphere	**405,673**	**376,580**	**487,591**	**474,896**	**475,231**	**+**	**69,558**	**+**	**17.1**
Total Non-Communist	**1,218,474**	**1,564,659**	**1,749,727**	**1,753,150**	**1,904,625**	**+**	**686,151**	**+**	**56.3**
U.S.S.R.	635,400	920,000	1,240,000	1,400,000	1,450,000	+	814,600	+	128.2
Others	29,000	35,000	43,800	46,800	47,400	+	18,400	+	63.4
Total Communist	**664,400**	**955,000**	**1,283,800**	**1,446,800**	**1,497,400**	**+**	**833,000**	**+**	**125.4**
TOTAL WORLD	**1,882,874**	**2,519,659**	**3,023,527**	**3,199,950**	**3,402,025**	**+**	**1,519,151**	**+**	**80.7**
Total OPEC	**561,600**	**980,150**	**1,018,564**	**1,017,629**	**1,118,247**	**+**	**556,647**	**+**	**99.1**
OPEC as % of World	29.9%	38.9%	33.7%	31.8%	32.9%		—		—

*Includes Brunei

Source: Oil & Gas Journal

OPEC production quotas

Country	(Thousand barrels per day) 1983 quota	1983 production	1984* quota	1984* production
Algeria	725	675	663	605
Ecuador	200	235	183	255
Gabon	150	150	137	150
Indonesia	1,300	1,385	1,189	1,335
Iran	2,400	2,426	2,300	2,155
Iraq	1,200	893	1,200	1,215
Kuwait	1,050	1,064	900	1,145
Libya	1,100	1,076	990	1,090
Nigeria	1,300	1,241	1,300	1,410
Qatar	300	295	280	395
Saudi Arabia	5,000	5,086	4,353	4,750
United Arab Emirates	1,100	1,147	950	1,145
Venezuela	1,675	1,768	1,555	1,710
Total	**17,500**	**17,441**	**16,000**	**17,360**

*Production quotas did not apply for full year

Source: OPEC and Author's estimates

come. No matter what diplomatic moves are made the economic picture indicates a massive available supply of clean burning fuel in the U.S.S.R. This will make them an attractive source for European energy needs.

The second largest reserves are in Iran, 16% of the total worldwide reserves. Because of the unsettled political situation it is much harder to predict the impact of Iran's reserve position on world production patterns. There are presently no plans for Iran to increase exports, and they claim to have plans to utilize the gas for internal development. This impact may be in terms of additional crude for export as they shift internal energy consumption to natural gas.

United States reserves have dropped sharply, falling 27.1% from 1973 to 1985. The present chaotic conditions in the United States gas market do not indicate a rapid improvement.

THE OUTLOOK — WORLDWIDE SUPPLY

	1985	1986	1987	1988	1989	1990	Change 1985 to 1990	% change 1985 to 1990
WORLD OIL PRODUCTION (total liquids) (thousands barrels/day)								
OPEC	18,200	18,040	17,395	18,730	21,090	22,830	+4,630	+25.4
Non-OPEC	24,830	25,300	25,600	25,900	26,000	26,050	+1,220	+ 4.9
Total Non Comm.	**43,030**	**43,340**	**42,995**	**44,630**	**47,090**	**48,880**	**+5,850**	**+13.6**
Communist	15,270	15,390	15,505	15,620	15,720	15,820	+ 550	+ 3.6
Total	**58,300**	**58,730**	**58,500**	**60,250**	**62,810**	**64,700**	**+6,400**	**+11.0**
World refining capacity (thousands barrels/day)	56,900	56,200	55,500	55,500	55,500	55,500	−1,400	− 2.5
World crude runs (thousand barrels/day)	42,670	43,050	43,000	44,120	45,890	47,270	+4,600	+10.8
Refinery utilization rate	75.0%	76.6%	77.5%	79.5%	82.7%	85.2%	—	—
Active drilling rigs (outside U.S. & Canada)	1,290	1,315	1,340	1,370	1,410	1,450	+ 160	+12.4
Crude oil price (av. world export price) ($/barrel)	$25.75	$24.50	$22.50	$22.00	$23.00	$23.50	−$2.25	− 8.7

U.S. Outlook — Demand

U.S. Outlook—Demand

WHEN YOU get down to the basics, oil and natural gas are simply two of the fuels that provide energy for economic activity. On the other hand, they are essential for manufacturing and expanding the level of economic output in the U.S.

The demand for energy and demand for petroleum products and natural gas are dependent upon the level of economic output. And any forecast/outlook of future demand is dependent upon assumptions concerning the level of U.S. economic activity.

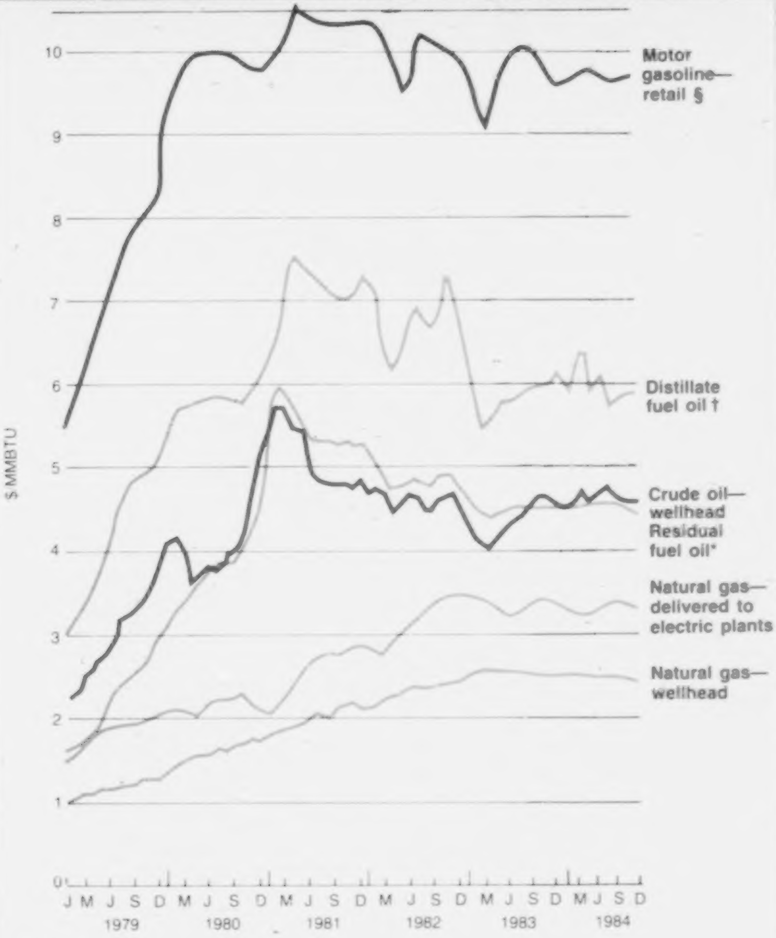
Since 1973 the U.S. economy has gone through two recessions. Both followed major increases in oil prices and increases in energy costs in general. One recession was in 1974-1975 when real Gross National (GNP) expressed in 1972 dollars, fell 1.8% over 2 years. The second occurred in 1982 when real GNP fell 2.1%. Between 1979 and 1982 the economy grew only 0.7%, virtually not at all. The U.S. economy began pulling out of the most recent recession during 1983. Real GNP moved up 3.7% in 1983. The pace of economic growth accelerated in 1984 with real GNP increasing 6.8%.

The business cycle is not dead. It is expected that economic growth will slow in 1985 with real GNP moving up about 2.7%-3.0%. Expectations are that the rate of growth will continue to slow in 1986. And the heavy burden of government, corporate and personal debt will help bring economic growth almost to a standstill by 1987. However, spurred by much lower real energy costs and aided by a plan for reducing the debt burden, the economy is expected to rebound vigorously at the end of the planning period 1988-1990. By the end of the decade it is expected that productivity will have improved and interest rates will be somewhat lower, also helping boost economic activity. Real GNP is expected to be up approximately 21.5% by 1990.

The lock-step relationship between economic growth and energy demand in the U.S. was broken in 1970. From 1950 through 1970, real GNP increased 101.3%. Over the same period, energy consumption increased 96.6%. The amount of energy consumed per dollar of GNP fell only slightly from 64,000 BTU per dollar of GNP in 1950, to 62,500 BTU in 1970.

From 1970 through 1984, GNP increased 52.6%, but energy consumption moved up only 9.8%. Over that 14 year period, the growth of energy and GNP moved from a one-to-one relationship to a 0.18-to-one relationship, meaning that energy consumption in-

Petroleum product and natural gas prices



*Retail, excluding tax

† Refiners average selling price to resellers & retailers

§Average all grades, including tax

Source: Energy Information Administration

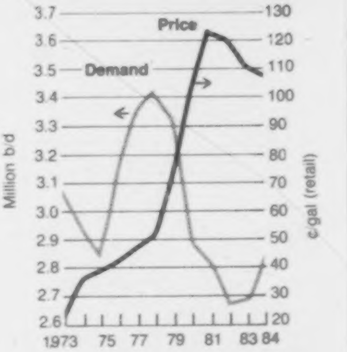
Prices of fossil fuels used in electric generation

	Coal	Residual oil	Natural gas	All fossil fuels	Residual oil price as % of Coal	Residual oil price as % of Natural gas
	(¢ MMBTU)					
1973	40.5	78.5	33.8	47.6	193.8	232.2
1974	70.9	189.0	48.2	91.4	266.6	392.1
1975	81.4	200.5	75.2	104.4	246.3	266.6
1976	84.8	195.2	103.4	111.9	230.2	188.8
1977	94.7	219.8	129.1	129.7	232.1	170.3
1978	111.6	212.5	142.2	141.1	190.4	149.4
1979	122.4	298.8	174.9	163.9	244.1	170.8
1980	135.1	426.7	219.9	192.8	315.8	194.0
1981	153.2	533.4	280.5	225.6	348.2	190.2
1982	164.7	483.2	337.6	224.9	293.4	143.1
1983	165.6	457.8	347.4	220.6	276.4	131.8
1984	166.4	480.7	356.3	219.0	288.9	134.9

*Delivered price to steam-electric utility plants

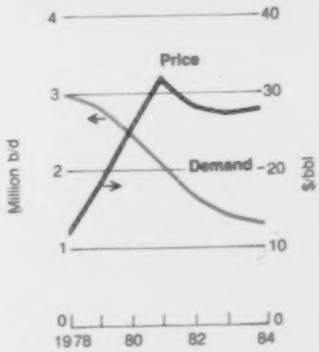
Source: Department of Energy

Distillate fuel oil demand and price



Source: American Petroleum Institute and Energy Information Administration

Residual demand and price



Source: Energy Information Administration

creased only 1.8% for every 10% increase in economic activity. This was a dramatic shift from the previous 20 years.

Total energy consumption per GNP dollar fell for 14 consecutive years, from 62.4 thousand BTU in 1970 to 45.0 thousand in 1984. This was a 27.9% improvement in the efficiency of energy consumed. The rapid increase in the price of energy in the 1970s was a major reason for the improvement in energy efficiency. The rising cost of energy relative to other factors of production provided cost-cutting and profit incentive for minimizing energy requirements.

The oil price hikes of 1973-1974 and 1979-1981 rapidly boosted the cost of petroleum products and the cost of energy in general. This had the effect of providing additional incentive for conservation and accelerated the drop in energy use per dollar of GNP.

Following the 1973-1974 price hike the economy went into a recession with real GNP falling in 1974 and 1975. Energy consumption fell from 74,288 trillion BTU in 1973 to 70,551 trillion BTU in 1975, a decline of 5%. Following the 1979-1981 price hike the economy went into a recession in 1982. Due to the price induced conservation energy consumption actually started falling in 1980 and the fall accelerated with the drop in economic activity. Energy consumption fell for four consecutive years, dropping 10.7% from 78,900 trillion BTU in 1979 to 70,497 trillion BTU in 1983.

Oil prices have been falling since 1981 and are down 20-30% from the peak. And other energy costs have leveled off. This has moderated the incentive for conservation. During 1984 real GNP increased 6.8% and energy consumption moved up 4.[illegible] This is a ratio of 0.68 to 1, and is a sharp increase in r[illegible]e energy consumption.

Petroleum energy consumed per dollar of GNP a[illegible] has been falling, particularly since the second oil price hike in 1979. Petroleum energy consumed per dollar of GNP has fallen from 27.1 thousand BTU in 1977 to 18.9 thousand BTU in 1984.

This trend in the energy and real GNP relationship is expected to continue for the forseeable future. The energy required for a dollar of real GNP is expected to fall to about 41,800 in 1990. And petroleum energy per dollar of GNP is expected to fall to 17,400 in 1990.

A substantial part of the more efficient use of energy has been due to price induced conservation following the rapid and sharp increase in energy costs. But the shift in the profile of the economy also has been an important factor. The U.S. is moving from a principally industrial economy to a more service and information oriented economy. These latter types of economic activity are far less energy intensive.

The response to price increases can be spread out over an extended period. It is rapid in the transportation sector but much slower in the residential/commercial, utility, and industrial sectors. In those sectors, adjustment can extend over 10 or more years. A major portion of this demand adjustment is permanent, since it is due to investment in improved capital goods.

There is already some evidence that declining real prices of energy could relatively quickly stop the decline in energy consumption. Efficiency improvements would continue but would be more than offset by the increase in energy consumption due to economic growth.

In the U.S., there has been a shift in energy consumption away from the industrial sector to the residential/commercial and transportation sectors. Consumption in the industrial sector has dropped from

Factors determining motor gasoline demand

	Total vehicle registrations* (1,000)	Total vehicle miles of travel (billion)	Average of passenger cars in use (years old)	Fuel consumed per vehicle (gallons)
1970	108,418	1,120.7	5.6	830
1975	132,962	1,330.1	6.0	790
1980	155,890	1,520.9	6.6	711
1981	158,457	1,556.5	6.9	697
1982	159,510	1,592.5	7.2	686
1983	161,939	1,630.1	7.4	688

*Excludes military vehicles

Source: Motor Vehicle Manufacturers Assoc. Facts & Figures Report 1984

Refined product prices

	Regular Motor gasoline pump price (¢/gal)	No. 2 heating oil retail price (¢/gal)	Value of petroleum imports ($/bbl)	Refiners' acquisition cost composite ($/bbl)
1971	36.43	19.63	2.31	3.60
1972	36.13	19.72	2.47	3.58
1973	38.82	22.75	3.30	4.15
1974	52.41	36.01	10.81	9.07
1975	57.22	38.98	11.19	10.38
1976	59.47	41.80	12.15	10.89
1977	63.07	47.37	13.81	11.96
1978	65.71	50.80	14.12	12.46
1979	87.79	72.80	18.72	17.72
1980	121.72	100.97	30.60	28.07
1981	131.10	124.66	34.28	35.24
1982	122.20	120.86	31.48	31.87
1983	115.70	110.12	28.58	28.99
1984	114.60	109.30	28.30	28.63

Source: American Petroleum Institute and Energy Information Administration

Crude oil prices

	Saudi Light	U.S. average wellhead	Refiners' acquisition cost		
			Domestic	Imported	Composite
	(Dollars per barrel)				
1970	1.35	3.18	3.46	2.96	3.40
1971	1.75	3.39	3.68	3.17	3.60
1972	1.90	3.39	3.67	3.22	3.58
1973	2.10	3.89	4.17	4.08	4.15
1974	9.60	6.87	7.18	12.52	9.07
1975	10.46	7.67	8.39	13.93	10.38
1976	11.51	8.19	8.84	13.48	10.89
1977	12.09	8.57	9.55	14.53	11.96
1978	12.70	9.00	10.61	14.57	12.46
1979	13.34	12.64	14.27	21.67	17.72
1980	26.00	21.59	24.23	33.89	28.07
1981	32.00	31.77	34.33	37.05	35.24
1982	34.00	28.52	31.22	33.55	31.87
1983	29.00	26.19	28.87	29.30	28.99
1984	28.00	25.88	28.53	28.88	28.63
Change 1981-1984	4.00	5.89	-5.80	8.17	-6.61
% change 1981-1984	-12.5%	18.5%	-16.9%	22.1%	-18.8%
Change 1970-1984	26.65	22.70	25.07	25.92	25.23
% change 1970-1984	1974.1%	713.8%	724.6%	875.7%	742.1%

Source: Energy Information Administration

Refined petroleum products supplied by type

	(Million b/d)														
	Motor gasoline	% of total	Jet fuel	% of total	Distillate fuel oil	% of total	Residual fuel oil	% of total	Ethane and liquefied gases	% of total	Other products	% of total	Total products	% of total	% change from previous year
1972	6.38	38.9	1.05	6.4	2.91	17.8	2.53	15.5	1.42	8.7	2.08	12.7	16.37	100.0	7.9
1973	6.67	38.5	1.06	6.1	3.09	17.9	2.82	16.3	1.45	8.4	2.21	12.8	17.31	100.0	5.7
1974	6.54	39.3	0.99	5.9	2.95	17.7	2.64	15.8	1.41	8.5	2.13	12.8	16.65	100.0	-3.8
1975	6.67	40.9	1.00	6.1	2.85	17.5	2.46	15.1	1.33	8.1	2.00	12.3	16.32	100.0	-2.0
1976	6.98	40.0	0.99	5.6	3.13	17.9	2.80	16.0	1.40	8.1	2.16	12.4	17.46	100.0	7.0
1977	7.18	38.9	1.04	5.6	3.35	18.2	3.07	16.7	1.42	7.7	2.37	12.9	18.43	100.0	5.6
1978	7.41	39.3	1.06	5.6	3.43	18.2	3.02	16.0	1.41	7.5	2.51	13.4	18.85	100.0	2.3
1979	7.03	38.0	1.08	5.8	3.31	17.9	2.83	15.3	1.59	8.6	2.67	14.4	18.51	100.0	-1.8
1980	6.58	38.6	1.07	6.3	2.87	16.8	2.51	14.7	1.47	8.6	2.57	15.0	17.06	100.0	-7.8
1981	6.59	41.0	1.01	6.3	2.83	17.6	2.09	13.0	1.47	9.1	2.08	13.0	16.06	100.0	-5.9
1982	6.54	42.7	1.01	6.6	2.67	17.5	1.72	11.2	1.50	9.8	1.86	12.2	15.30	100.0	-4.7
1983	6.62	43.5	1.04	6.8	2.69	17.7	1.42	9.3	1.51	9.9	1.94	12.8	15.23	100.0	-0.5
1984	6.70	42.6	1.17	7.4	2.85	18.1	1.37	8.7	1.58	10.1	2.04	13.1	15.71	100.0	3.2

Source: Energy Information Administration, Annual Report to Congress, Vol. 2

31.54 quads in 1973 to 25.91 quads in 1983, a drop of 17.8%. The industrial sector share of total energy consumption dropped from 42.5% to 36.8%. This reflects conservation and more efficient use of energy in the industrial sector, as well as the diminishing importance of the industrial sector in the total economy. However, there was a rebound in energy consumption by the industrial sector in 1984. Energy consumption moved up 7.5% to 37.8% of the total. Expectations are that the relative importance of the industrial sector will continue to slide. But an upturn in economic activity will slow the slide.

Residential/commercial sector energy consumption has increased from 24.15 quads in 1973 to 25.44 quads in 1983, an increase of 5.4%. This sector's share of the total market increased from 32.5% to 36.1%. The growth in this sector of the economy has more than offset the improvement in energy efficiency and conservation. In 1984 energy consumption in this sector moved up 2.2% but share of total energy consumption dropped to 35.3%. Growth in this sector is expected to be slow but steady over the forecast period, reflecting the shift to a more service and information oriented economy.

Consumption of energy in the transportation sector has shown a modest increase, moving up 3% from 18.60 quads in 1973 to 19.15 quads in 1983. The share of total energy consumption increased from 25% to 27.1%. Although there has been continued improvement in vehicle fuel efficiency, the total vehicle fleet has been increasing along with the population. And as gasoline and diesel fuel prices have leveled off during the past 2 years, there has been less incentive for discretionary personal conservation.

This was evident in 1984 when consumption in the transportation sector increased 3.7%.

There has not only been a shift in the end use of energy but also a shift in the source of energy. Over the past 10 years, coal and nuclear energy have been growing in share of the energy market while petroleum and natural gas have been declining. The increase in demand for energy in the form of electrical power has been the primary reason for the increase in coal consumption and nuclear power generation.

Coal energy consumption moved up 32.3% from 1973 through 1984. And coal has increased its share of the energy market from 17.5% in 1973 to 23.3% in 1984.

Energy from nuclear power increased 292.6% from 1973 to 1984. Share of the market moved up from 1.2% in 1973 to 4.8% in 1984.

Both of these energy sources are expected to increase market share over the forecast period. Coal is expected to move up to 24.7% of the market in 1990. And nuclear will increase its share of the market to 5.8%.

The other major source of power is hydroelectric, geothermal and other. Combined they represent 4.1% of energy consumed in 1973. This moved up to 5.4% in 1984 but is expected to drop to 4.4% in 1990. The vast majority of the energy comes from hydropower where the maximum capacity is relatively fixed and year to year output is dependent upon the weather.

Over the same 1973 to 1984 period the petroleum share of the energy market fell from 46.9% to 42.1%. Energy from petroleum fell 11% while total energy consumption in 1984 was only 0.8% lower than 1973. The petroleum share of the market is expected to continue to slide moving down to 41.6% in 1990.

The natural gas share of the total energy market has fluctuated

Economic growth and energy consumption

Year	GNP constant 1972 dollars (billion)	Total energy consumption (trillion BTU)	Total energy consumption per GNP dollar (thousand BTU)	Petroleum energy consumption (trillion BTU)	Petroleum energy consumption per GNP dollar (thousand BTU)
1929	315	23.756	75.4	5.298	16.8
1933	222	16.900	76.1	4.833	21.8
1940	343	23.589	68.8	7.407	21.6
1946	477	30.494	63.9	10.002	21.0
1950	534	34.153	64.0	12.705	23.8
1955	655	39.956	61.0	16.302	24.9
1960	737	44.816	60.8	18.643	25.3
1965	926	53.343	57.6	21.391	23.1
1970	1.075	67.143	62.5	27.059	25.2
1971	1.108	63.348	57.2	28.023	25.3
1972	1.171	71.609	61.2	30.291	25.9
1973	1.254	74.288	59.2	34.840	27.8
1974	1.246	72.548	58.2	33.455	26.8
1975	1.232	70.551	57.3	32.731	26.6
1976	1.298	74.366	57.3	35.175	27.1
1977	1.370	76.292	55.7	37.122	27.1
1978	1.439	78.091	54.3	37.965	26.4
1979	1.479	78.900	53.3	37.123	25.1
1980	1.475	75.955	51.5	34.202	23.2
1981	1.512	73.989	48.9	31.931	21.1
1982	1.480	70.842	47.9	30.232	20.4
1983	1.535	70.497	45.9	30.054	19.6
1984	1.640	73.730	45.0	31.004	18.9
Percentage change					
1929-40	8.9%	0.7%	—	39.8%	—
1940-50	55.7%	44.8%	—	71.5%	—
1950-70	101.3%	96.6%	—	113.0%	—
1970-84	52.6%	9.8%	—	14.6%	—

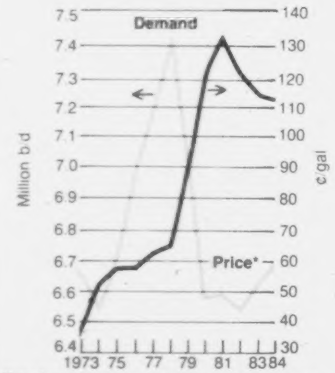
Source: U.S. Department of Energy

U.S. energy consumption by source

	Petroleum	% of total	Natural gas	% of total	Coal	% of total	Nuclear	% of total	Hydro and other	% of total	Total
	(Quadrillion BTU)										
1973	34.840	46.9	22.512	30.3	12.970	17.5	0.910	1.2	3.056	4.1	74.288
1974	33.455	46.1	21.732	30.0	12.724	17.5	1.272	1.8	3.365	4.6	72.548
1975	32.731	46.4	19.948	28.3	12.682	18.0	1.900	2.7	3.291	4.6	70.552
1976	35.175	47.3	20.345	27.4	13.589	18.3	2.111	2.8	3.147	4.2	74.367
1977	37.122	48.7	19.931	26.1	13.940	18.3	2.702	3.5	2.597	3.4	76.292
1978	37.965	48.6	20.000	25.6	13.892	17.8	3.024	3.9	3.209	4.1	78.090
1979	37.123	47.1	20.666	26.2	15.105	19.1	2.776	3.5	3.230	4.1	78.900
1980	34.202	45.0	20.391	26.8	15.391	20.3	2.739	3.6	3.232	4.3	75.955
1981	31.931	43.2	19.926	26.9	15.892	21.5	3.008	4.1	3.232	4.3	73.989
1982	30.232	42.7	18.507	26.1	15.302	21.6	3.131	4.4	3.669	5.2	70.841
1983	30.054	42.6	17.352	24.6	15.884	22.5	3.203	4.5	4.004	5.8	70.497
1984	31.004	42.1	18.031	24.5	17.192	23.3	3.546	4.8	3.957	5.3	73.730

Source: Energy Information Administration

Gasoline demand and price



*Major brand regular including state and federal taxes.
Source: American Petroleum Institute and Energy Information Administration

Energy consumption—end use sector

Year	Residential and Commercial	% of total	Industrial	% of total	Transportation	% of total	Total energy consumption
	(Quadrillion BTU)						
1973	24.15	32.5	31.54	42.5	18.60	25.0	74.29
1974	23.73	32.7	30.70	42.3	18.11	25.0	72.55
1975	23.90	33.9	28.41	40.3	18.24	25.8	70.55
1976	25.02	33.6	30.25	40.7	19.09	25.7	74.37
1977	25.39	33.3	31.09	40.7	19.81	26.0	76.29
1978	26.09	33.4	31.42	40.2	20.59	26.4	78.09
1979	25.81	32.7	32.63	41.4	20.46	25.9	78.90
1980	25.66	33.8	30.61	40.3	19.69	25.9	76.00
1981	25.24	34.1	29.25	39.5	19.50	26.4	74.00
1982	25.63	36.2	26.14	36.9	19.07	26.9	70.84
1983	25.44	36.1	25.91	36.8	19.15	27.1	70.50
1984	26.00	35.3	27.89	37.8	19.86	26.9	73.73

Source: Energy Information Administration

Refined petroleum products supplied to end-use sectors

	Residential and commercial	% of total	Industrial	% of total	Trans.	% of total	Electric utilities	% of total	Total	% of total
	(Million b/d)									
1972	2.25	13.7	4.21	25.8	8.54	52.2	1.36	8.3	16.37	100.0
1973	2.23	12.9	4.50	26.0	9.03	52.2	1.54	8.9	17.31	100.0
1974	2.04	12.2	4.32	26.0	8.82	53.0	1.48	8.8	16.65	100.0
1975	1.95	12.0	4.06	24.8	8.93	54.7	1.39	8.5	16.32	100.0
1976	2.12	12.1	4.47	25.6	9.35	53.6	1.52	8.7	17.46	100.0
1977	2.14	11.6	4.85	26.3	9.74	52.8	1.71	9.3	18.43	100.0
1978	2.07	11.0	4.90	26.0	10.13	53.7	1.75	9.3	18.85	100.0
1979	1.73	9.3	5.35	28.9	9.99	54.0	1.44	7.8	18.51	100.0
1980	1.52	8.9	4.85	28.4	9.54	55.9	1.15	6.8	17.06	100.0
1981	1.33	8.3	4.29	26.7	9.47	59.0	0.96	6.0	16.06	100.0
1982	1.24	8.1	4.06	26.6	9.30	60.8	0.69	4.5	15.29	100.0
1983	1.19	7.8	4.03	26.5	9.33	6.12	0.68	4.5	15.23	100.0

Source: Energy Information Administration, Annual Report to Congress, Vol. 2

more than for petroleum but has also moved down since 1973. Natural gas represented 30.3% of the market in 1973 and fell to 24.4% in 1984. Energy from natural gas was 20% lower in 1984 than in 1973. The natural gas share of the market is forecast to fall to 23.5% in 1990.

In 1973 petroleum and natural gas combined accounted for 77.2% of the energy consumed in the U.S. This had fallen to 66.5% in 1984 and is expected to slide to 65.1% in 1990. A definite downward trend, but still almost two thirds of all energy consumed in the U.S.

Adjustment to the rising cost of energy not only takes the form of conservation but also the form of fuel switching. Fuel switching takes time. This is a reaction to price change that is spread out over many years. It requires a substantial capital investment in most cases, and, therefore, the response is dependent upon a more complex economic evaluation, one which includes the capital investment cost of alternative fuel facilities.

What is happening in the industrial and utility sectors and to a lessor degree in the residential sector, is that multifuel capabilities have been installed. This enables end users to choose the lowest cost fuel and will work toward keeping the BTU cost of competing fuels relatively close.

From the perspective of demand for petroleum products, residual fuel oil is in direct competition with coal and natural gas in the industrial and utility sector of the economy. Distillate fuel oil and natural gas compete in the residential sector.

The cost of fuels delivered to steamelectric utility plants gives a good picture of how the relative cost of competing fuels has shifted over the past several years. Coal has been, and still is, the cheapest fuel, followed by natural gas and then resid the most expensive. But the price differentials have changed. With limitations on new natural gas facilities and possibly some environmental limitations on coal use, there is a possibility that the lower relative cost of resid might make it an attractive alternative—particularly if substantial new investment is required to use more coal.

In 1973 the cost of heavy oil for steam-electric utility plants was 193.8% of the cost of coal. And heavy oil was 232.2% of the cost of natural gas. These relative prices moved up to heavy oil 348.2% of coal in 1981 and 190.2% of natural gas. Natural gas prices were also moving up rapidly over this period. The utility plant average cost for all fossil fuels increased 373.9% from 1973 to its peak in 1981.

Since 1981 heavy fuel costs have fallen. The costs of coal and natural gas have slowed their increase. In 1984 heavy oil cost was 289.2% of coal and 134.3% of natural gas. The average cost of all fossil fuels was down 2.8% from the peak. Heavy resid oil has become more competitive, particularly with respect to natural gas. And it is expected the prices will continue to converge over the forecast period.

Demand for petroleum products increased in 1984 after 5 consecutive years of decline. This drop in demand was unprecedented in duration. Domestic demand for petroleum products increased for 31 consecutive years from 1942 to 1973. The only downturn of any duration had been during the great depression when demand fell for 3 consecutive years between 1929 and 1932.

After the price hike in 1973-1974 demand for petroleum products fell 5.7% from 17.038 million b/d in 1973 to 16.322 million b/d in 1975. When prices leveled demand resumed its steady increase rising for 3 more years to peak at 18.847 million b/d in 1978. This was a

Exports of refined products and crude

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
	1,000 b/d									
Gasoline	2	4	2	2	1	1	2	20	10	6
Distillate	1	1	1	3	4	3	5	74	64	51
Residual	15	12	6	13	9	34	118	209	185	190
Lubricants	25	26	26	27	24	23	19	16	16	15
Coke	102	103	102	111	146	137	138	156	195	193
Asphalt and road oil	1	1	1	1	—	1	—	1	1	1
LPG	26	25	18	20	15	21	42	65	73	48
Other refined products	31	43	37	27	39	39	43	38	31	37
Total refined products	**203**	**215**	**193**	**204**	**238**	**259**	**367**	**579**	**575**	**541**
Crude	6	8	50	158	234	287	228	236	164	181
Total exports	**209**	**223**	**243**	**362**	**472**	**546**	**595**	**815**	**739**	**722**

Source: Department of Energy

sharp increase of 2.525 million b/d, 15.5% over 3 years.

The second price shock had an immediate impact on demand. Actually it was probably a combined impact from both price hikes. But demand fell 3.616 million b/d., 19.2% over the next 5 years, to 15.231 million b/d in 1983. Price induced conservation was the major reason for this decline but sluggish economic activity also contributed to the drop in petroleum demand.

Lower prices for petroleum products and substantial economic growth helped boost demand 3.1% in 1984, to 15.707 million b/d.

In the U.S. economy, demand for petroleum products has been falling in all sectors. The sharpest decline has been in consumption by electric utilities. But since the peak in 1978, demand is also down in the residential/commercial, industrial, and transportation sectors as well.

Since 1978, electric utilities have moved away from oil to coal and nuclear. Demand had dropped from 1.75 million b/d to approximately 644,000 b/d in 1984, down 63.2%. The share of total petroleum demand has fallen from 9.3% to only 4.1%. Competition from nuclear power, coal, and natural gas have all reduced demand in this sector. Industrial sector demand peaked in 1979 at about 5.3 million b/d. It fell to an estimated 4.1 million b/d in 1984, down 22.6%. The industrial sector share of total domestic demand has not changed a great amount. It was 25.9% in 1973, moved up to 28.9% in 1979 and was 25.7% in 1984.

Residential and commercial sector demand has been trending down since 1973. At that time, demand was 2.23 million b/d and represented 12.9% of the total. In 1984, residential and commercial demand was only 1.24 million b/d and 7.9% of the total. Conversion to natural gas and the use of natural gas for new buildings because of the price advantage was the main reason for the downward shift.

Transportation sector demand has dropped since peaking in 1978, but its share of total demand has risen. Demand hit 10.14 million b/d in 1978 and was down 3.5% to 9.8 million b/d in 1984. Over that period, the share of total demand increased from 53.8% to 67.3% in 1984. Petroleum products do not have major fuel competition in the transportation sector. The major reason for the drop in demand is improved efficiency of vehicles and the cost consciousness of users.

The combination of lower prices (substantially lower real prices) and economic growth are expected to boost total demand over the forecast period. But demand will tend to follow the pattern of economic activity. Total domestic demand is expected to increase only about 1.7% by 1986. Due to the expected economic slowdown demand is forecast to level off in 1987. But with renewed economic growth and lower oil prices the latter part of the planning period

1988-1990 will see a resurgence in demand. By 1990 demand is expected to be up 10.7%, an increase of 1.7 million b/d to 17.54 million b/d. This would be the highest level since 1979.

One of the things that was underestimated or ignored in some past outlooks was the price elasticity of demand for petroleum products. That is, the change in demand relative to a change in price.

There is no way to isolate demand for petroleum products and measure only the response due to price change, but the sharp price hikes, particularly in the late 1970s, enable the calculation of a rough estimate. Over the past few years the elasticity of demand for all petroleum products has been approximately 0.1. For every 10% increase in the price, demand fell 1%. This varied from product to product.

Although this would indicate that demand was relatively "inelastic", it does show that contrary to some preconceived notions, demand would fall if the price increase was too great.

From 1970 to 1981, the composite U.S. refiner acquisition cost of crude oil increased 936%, from $3.40/bbl to $35.24/bbl. This is an increase of $31.74/bbl and an annual average relative increase of 23.7%/year. Crude oil prices obviously determine product prices, which also skyrocketed. These massive price increases, far surpassing the overall rate of inflation, had a tremendous impact on investment and consumption decisions and resulted in a reduction in demand for oil products.

Since 1981, the price of crude has been falling. The composite U.S. refiner acquistion cost for 1984 was $28.63/bbl. This was a drop of 18.8% from the 1981 average price. Demand rebounded in 1984 increasing 3.1%. This is a roughly 1.6% increase in demand for every 10% decrease in price. There are obviously many factors affecting demand, but relative price is one. However, it will take a longer period to determine if demand elasticity is close to this estimate.

The impact of price on motor gasoline demand has not been as great as some other petroleum products, but it has been significant. Demand peaked in 1978 at 7.412 million b/d and then fell 11.8% to 6.539 million b/d in 1982. The price of gasoline obviously influenced driving behavior, reducing the number of miles driven and changing attitudes about types of vehicles. Drivers cut out a lot of wasted discretionary driving and also opted to purchase more fuel-efficient vehicles. Gasoline demand fell about 1% for every 10% increase in price. But, the major impact of the rapid increase in price was the federal government mandated vehicle fuel efficiency standards. This forced improvement in vehicle fuel-efficiency.

But as prices of gasoline have fallen demand has moved up. Motor gasoline demand was 6.698 million b/d in 1984, up 2.4% from 1982.

Motor gasoline demand is expected to move up over the forecast period but only marginally. There will be offsetting factors that will keep motor gasoline demand fairly constant. It is expected to be up only 3.8% from 1984, in 1990.

The total vehicle fleet is expected to increase along with the population. Improved economic conditions will give the driving segment of the population more discretionary income to spend on travel. The price of gasoline is down about 15% from the peak in 1981. And prices are not expected to rise during the early part of the forecast period. Therefore price is less of a factor when making driving decisions. All of those factors will be offset by the improved fuel efficiency of the vehicle fleet. All of the new additions as well as replacement vehicles will have better gas mileage and will increase the efficiency of the fleet. Improved economic conditions also mean more rapid scrappage of oil vehicles and replacement by newer more efficient cars.

The average fuel economy for passenger automobiles has increased from 13.1 miles per gallon in 1973 to 16.7 miles per gallon in 1983. The average fuel consumed per car has fallen from 763 gallons in 1973 to 577 gallons in 1983. The average miles driven per car however has moved with economic conditions and gasoline price. It peaked at 10,184 miles in 1972 and dropped to 9,448 miles in 1974. It then moved up to 10,046 miles per car in 1978 before falling to 9,002 miles in 1981. It then moved up 9,641 miles in 1983.

The once expected impact of new diesel powered cars is diminishing. Between 1983 and 1984 sales of diesel fueled automobiles declined 21.5%. And the largest U.S. auto manufacturer, General Motors, has begun to eliminate diesel powered vehicles from their passenger car line.

Demand for distillate fuel oil also peaked in 1978 at 3.432 million b/d. It then fell 22.2% to 2.671 million b/d in 1982. It has moved up over the last 2 years and was 2.848 million b/d in 1984.

The two major uses for distillate fuel are for residential and commercial heating, and for highway and rail transport. The residential and commerical use has been falling in terms of amount consumed and share of total distillate demand. Consumption fell from 1.014 million b/d in 1979 to 704 thousand b/d in 1984. Share of distillate demand fell from 30.5% to 24.7%.

Between 1978 and 1981, the price of home heating oil increased 165.1% from 38.7¢/gal to $1.026/gal. This resulted in a sharp shift to natural gas for heating and a sharp cut in fuel oil used.

Between 1978 and 1983, the number of oil burners in use dropped from 12.304 million to 10 million, down 18.7%. In addition, the fuel used per burner dropped from 38.2 bbl in 1976 to only 27.1 bbl in 1983. During the decline, distillate demand fell about 1.25% for every 10% increase in price.

The drop in price in the last couple of years will stimulate demand. Home heating oil has become competitive with natural gas in some areas and has slowed conversions. Residential and commercial consumption moved up 5.1% in 1984.

The upswing in the economy should also stimulate demand, particularly diesel fuel for highway transport.

Highway diesel demand moved up from 897,000 b/d in 1979 to 1.084 million b/d in 1984, an increase of 20.8%. Share of total distillate demand increased from 27% to 38.1% over the same period. Lower prices and increased economic activity are expected to boost that throughout the forecast period.

Distillate demand is forecast to increase 17.3% during the forecast period. There is a close relationship between distillate demand, particularly for transport, and overall economic growth.

Over half of the drop in petroleum demand between 1978 and 1984 can be attributed to the drop in demand for residual fuel oil. Over those 6 years, demand for resid fell from 3.02 million b/d to 1.365 million b/d, a drop of 1.658 million b/d, down 54.8%. Total demand for petroleum products fell 3.14 million b/d. Resid accounted for 52.8% of the decline. The shift by electric utilities from residual fuel oil to cheaper fuel sources, coal, nuclear, and hydro, was the major reason for the drop in resid demand.

In 1978, almost half of the resid consumed was by the utility sector, 48.3% or 1.461 million b/d. By 1984, utility sector demand had fallen an estimated 63.8% to only 529 thousand b/d. Industrial demand was also down sharply, falling from 622,000 b/d in 1978 to only 289,000 b/d in 1984. The resid demand response to the price increases was a lot greater. With more competition from competing fuels, resid demand tends to be more "elastic" Resid demand fell about 3% for every 10% increase in price.

Demand for resid may be one of the keys to the level of future overall demand for petroleum products. Prices for resid have been falling sharply. This is expected to stop the sharp decline in resid demand in 1985 at around 1.2 million b/d. Resid demand is expected to move up marginally through 1988 but then possibly accelerate toward the end of the planning period. There may well be an increase in resid consumption starting at that time, for electrical power generation.

With limitations on expanding nuclear power and some potential limits on coal due to acid rain, resid and natural gas may be the fuels for power generation in the 1990's.

Due to lower actual and real prices demand for other petroleum products is also expected to increase over the forecast period. Consumption of jet fuel is expected to increase at close to the pace of economic activity. Demand for other petroleum products is expected to move up along with increased economic activity but a slower rate. Improved energy efficiency and the changing economy have altered the petroleum energy economic growth rates permanently.

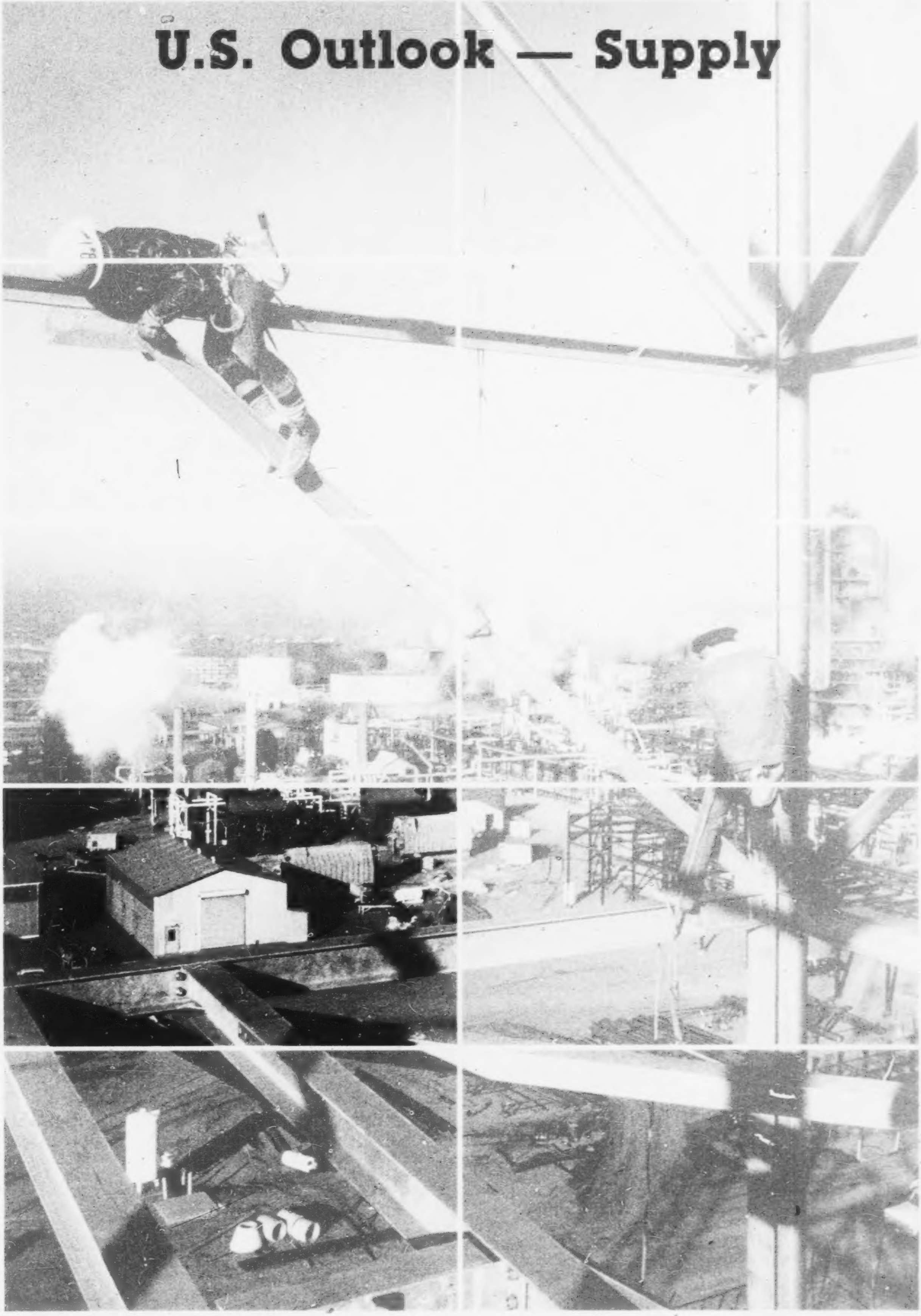
One factor that is holding back a major resurgence in oil demand is the long range price expectations.

Even though prices are lower now the long range expectation is for higher oil prices. And since increased demand of any significant amount must be met by OPEC production, potential consumers are reluctant to commit to capital equipment that requires oil consumption.

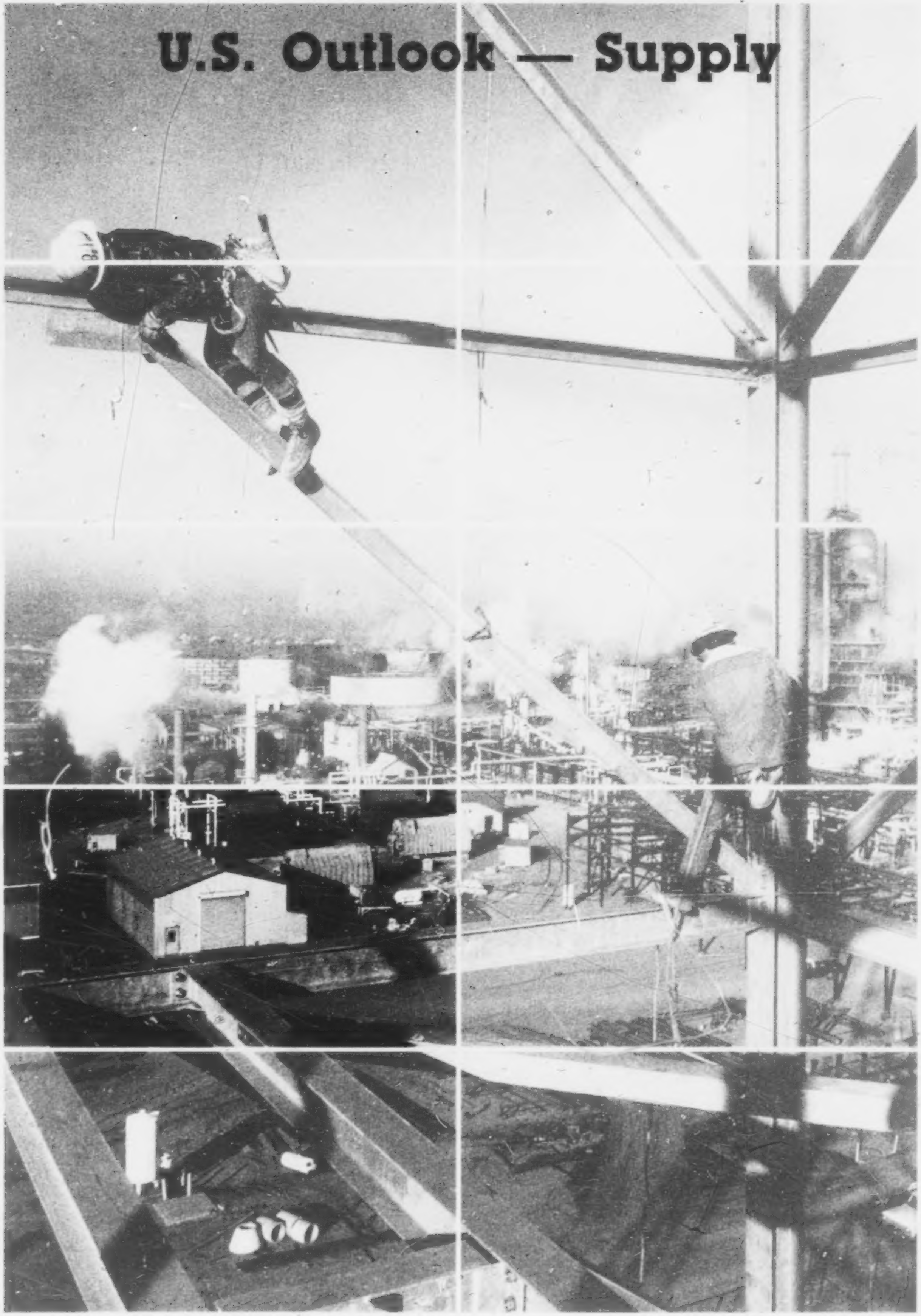
THE OUTLOOK — U.S. DEMAND

	1985	1986	1987	1988	1989	1990	Change 1985 to 1990	% change 1985 to 1990
ENERGY DEMAND (trillion BTU)								
Petroleum	31,283	31,565	31,570	32,350	33,640	34,650	+3,367	+10.8
Natural Gas	18,489	18,803	18,800	18,890	19,450	19,550	+1,061	+5.7
Coal	17,719	18,321	18,360	18,910	19,850	20,550	+2,831	+16.0
Nuclear	3,768	3,994	4,200	4,350	4,660	4,860	+1,092	+29.0
Hydro and Other	3,865	3,681	3,620	3,650	3,675	3,700	−165	−4.3
Total	**75,124**	**76,364**	**76,550**	**78,150**	**81,275**	**83,310**	**+8,186**	**+10.9**
PETROLEUM DEMAND (thousand barrels/day)								
Motor Gasoline	6,741	6,760	6,760	6,820	6,900	6,955	+214	+3.2
Jet Fuel	1,223	1,250	1,255	1,305	1,385	1,435	+212	+17.3
Distillate	2,950	3,000	3,000	3,130	3,320	3,460	+510	+17.3
Resid	1,218	1,220	1,225	1,265	1,355	1,475	+257	+21.1
Ethane and LPG	1,620	1,635	1,635	1,685	1,780	1,840	+220	+13.6
Other Products	2,090	2,115	2,110	2,175	2,290	2,375	+285	+13.6
Total	**15,842**	**15,980**	**15,985**	**16,380**	**17,030**	**17,540**	**+1,698**	**+10.7**
CRUDE OIL PRICE (U.S. wellhead price) ($/barrel)	$24.25	$23.10	$21.30	$21.00	$21.75	$22.20	−$2.05	−8.5

U.S. Outlook — Supply



U.S. Outlook — Supply



U.S. Outlook—Supply

THE OUTLOOK from the supply side is possibly more predictable than for demand. But there have also been considerable changes in the elements of supply over the past few years.

Demand for petroleum products can only be met by domestic liquids production plus imports of crude and products. And in the short run crude and product stocks can help satisfy demand. Since U.S. domestic production is unable to support total domestic demand for petroleum products a substantial volume of imports are required. Imports are generally the swing supply source and will vary with demand. While domestic production is dependent upon availability.

And availability is to a certain extent dependent upon the price and cost of production. The price of crude influences the supply that is made available just as price influences demand. However, the supply response to price is slower than the response of product demand. New supply is dependent upon incurring the cost and taking the risks to find the crude oil, NGL, and natural gas that is available.

Looking at the last several years, U.S. crude and condensate production declined from 9.477 million b/d in 1972 to 8.119 million b/d in 1976, a drop of 1.358 million b/d or 14.3%. With the development of the Alaskan North Slope, production jumped to 8.701 million b/d in 1978. But then production started on the decline again, falling to 8.572 million b/d in 1981.

But the high crude prices as a result of the OPEC price hike stimulated domestic exploration and drilling, and production moved up to an estimated 8.757 million b/d in 1984 according to the latest DOE figures.

This 1984 production figure is being revised upward as additional state figures become available. The latest estimates indicate a 1984 production level around 8.85 million b/d. This would be an increase of 3.2%, 278,000 b/d since 1981.

The drilling and development splurge over the 1979-1982 period helped slow the expected decline rate in the lower-48 states. And increased production in Alaska has boosted total U.S. domestic output. This increase in U.S. domestic production was a direct result of the increase in the price of crude oul. This rapid increase in price stimulated domestic exploration and drilling, and encouraged the development of previously uneconomic reserves.

In the last several years declining output in the Lower 48 states has been offset by increased production from Alaska. Lower 48 produc-

U.S. refined products, natural gas liquids, and crude stocks

Refined product stocks	1975	1976	1977	1978	1979	1980	1981	1982*	1983	1984
	1,000 bbl									
Gasoline	237,949	234,272	260,624	240,694	240,159	264,011	256,425	247,085	225,042	208,117
Motor	234,925	231,432	257,578	237,885	237,503	261,327	253,001	244,279	222,434	205,391
Aviation	3,024	2,840	3,046	2,809	2,656	2,684	3,424	2,806	2,608	2,726
Special naphthas	4,373	4,441	4,034	4,071	4,196	4,929	3,965	3,474	3,153	2,951
Kerosine	15,556	12,514	18,015	14,334	15,821	11,568	11,042	10,792	7,861	11,876
Distillate	208,787	185,986	250,280	216,367	228,706	205,113	191,541	185,579	140,263	161,136
Residual	74,126	72,344	89,673	90,204	95,859	91,786	77,992	68,229	48,504	53,214
Kerosine jet fuel	25,158	25,590	28,283	27,707	32,926	35,723	34,011	32,001	32,346	35,118
Naphtha jet fuel	5,222	6,495	6,285	5,960	5,594	6,308	7,054	7,189	6,265	6,861
Natural gas liquids & LRG	126,589	109,883	128,518	134,890	125,597	137,460	150,170	114,497	116,817	108,470
Unfinished oils	106,352	110,488	113,190	108,723	117,652	123,938	111,348	105,277	108,018	93,740
Other refined products	51,425	48,404	48,577	53,053	45,274	45,426	46,295	44,023	42,429	79,569
Total product stocks	**855,537**	**810,417**	**947,479**	**896,003**	**911,784**	**926,262**	**889,843**	**818,146**	**730,698**	**761,052**
Crude stocks†	271,354	285,471	339,813	309,421	339,080	358,166	363,464	350,044	343,850	343,522
Total stocks	**1,126,891**	**1,095,889**	**1,287,292**	**1,205,424**	**1,250,864**	**1,284,482**	**1,253,307**	**1,168,190**	**1,074,548**	**1,104,574**

*Change in Energy Information Administration reporting basis

†Excludes stocks for Strategic Petroleum Reserve

Source: Energy Information Administration

U.S. liquids production and reserves

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	% change 79/72	% change 84/79	% change 84/72
	(1,000 b/d)															
Crude & condensate production:																
California	951	921	884	883	892	958	935	966	975	1,055	1,100	1,109	1,126	1.6	16.6	18.4
Kansas	202	181	169	162	160	158	153	156	164	180	193	196	207	-22.8	32.7	2.5
Louisiana	2,455	2,278	2,018	1,796	1,686	1,542	1,460	1,355	1,283	1,231	1,256	1,314	1,404	-44.8	3.6	-42.8
New Mexico	302	276	267	259	251	239	230	217	206	196	195	206	213	-28.1	-1.8	-29.5
North Dakota	56	55	54	56	59	64	64	84	110	124	130	139	144	50.0	71.4	157.1
Oklahoma	567	524	487	447	441	428	418	393	410	422	435	435	460	-30.7	17.0	-18.9
Texas	3,565	3,546	3,454	3,347	3,251	3,117	2,948	2,776	2,672	2,589	2,535	2,473	2,473	-22.1	-10.9	-30.6
Wyoming	386	389	386	349	319	306	376	361	345	358	324	324	323	-6.5	-10.5	-16.3
Others	791	839	852	872	887	904	872	843	815	808	785	778	672	6.6	-20.3	-15.0
Total Lower 48	**9,275**	**9,009**	**8,571**	**8,171**	**7,946**	**7,716**	**7,456**	**7,151**	**6,980**	**6,963**	**6,953**	**6,974**	**7,022**	**-22.9**	**-1.8**	**-24.3**
Alaska	202	199	193	191	173	463	1,245	1,402	1,617	1,609	1,696	1,714	1,735	594.1	23.8	758.9
Total U.S.	**9,477**	**9,208**	**8,764**	**8,362**	**8,119**	**8,179**	**8,701**	**8,553**	**8,597**	**8,572**	**8,649**	**8,688**	**8,757**	**-9.7**	**2.4**	**-7.6**
NGL production:																
Total U.S.	1,748	1,738	1,688	1,633	1,603	1,618	1,567	1,584	1,573	1,609	1,550	1,559	1,633	-9.4	3.1	-6.6
Total liquids production:																
Total U.S.	11,225	10,946	10,452	9,995	9,722	9,797	10,268	10,137	10,170	10,181	10,199	10,247	10,390	-9.7	2.5	-7.4
	(Million bbl)															
Total U.S. Reserves																
Crude	36,339	35,299	34,250	32,682	30,942	29,486	27,804	27,051	29,805	29,426	27,858	27,735	27,300	-25.6	0.9	-24.9
NGL	6,787	6,455	6,350	6,268	6,402	5,994	5,926	5,655	6,728	7,068	7,221	7,901	7,950	-16.7	+40.6	+17.1
Total	**43,126**	**41,754**	**40,600**	**38,950**	**37,344**	**35,480**	**33,730**	**32,706**	**36,533**	**36,494**	**35,079**	**35,636**	**35,250**	**-24.2**	**+7.8**	**-18.3**
	(Years)															
Reserves/production ratio:																
Crude	10.51	10.50	10.71	10.71	10.44	9.88	8.75	8.67	9.50	9.40	8.82	8.75	8.54			
NGL	10.63	10.18	10.31	10.52	10.94	10.15	10.36	9.78	11.72	12.04	12.76	13.89	13.33			
Total	**10.53**	**10.45**	**10.64**	**10.68**	**10.52**	**9.92**	**9.00**	**8.84**	**9.84**	**9.82**	**9.42**	**9.53**	**9.30**			

Source: American Petroleum Institute; Energy Information Administration

Crude and product imports: relation to demand

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	% change 77/72	% change 84/77
	(1,000 b/d)														
Imports:															
Crude	2,222	3,244	3,477	4,105	5,287	6,594	6,195	6,452	5,219	4,141	3,323	3,096	3,205	+196.8	-51.4
Products	2,532	3,012	2,635	1,951	2,026	2,193	2,008	1,937	1,646	1,599	1,625	1,722	1,979	-13.4	-9.8
Total	**4,754**	**6,256**	**6,112**	**6,056**	**7,313**	**8,787**	**8,203**	**8,389**	**6,865**	**5,740**	**4,948**	**4,818**	**5,184**	**+84.8**	**-41.0**
Domestic demand	16,367	17,308	16,653	16,322	17,461	18,431	18,847	18,513	17,056	16,058	15,296	15,231	15,707	+12.6	-14.8
Dependency ratio:															
Imports/demand	29.1	36.2	36.7	37.1	41.9	47.7	43.5	45.3	40.3	35.8	32.4	31.6	33.0		

Source: Energy Information Administration

tion fell from 9.275 million b/d in 1972 to 6.953 million b/d in 1982, a drop of 2.322 million b/d, down 25%.

Effects of the drilling boom began to show up in 1983 as lower-48 output moved up marginally to 6.974 million b/d. This was an increase of 21,000 b/d, only 0.3% but a complete reversal of the expected constant rate of decline. Lower-48 production continued to move up in 1984 with estimated output of 7.11 million b/d.

Alaskan production has been moving up since the development of the North Slope in 1977-78. Production increased to 1.735 million b/d in 1984. This is an increase of 39.4% from the 1978 output of 1.245 million b/d.

It is anticipated that the expected decline in lower-48 production will resume in the latter part of 1985 and continue throughout the forecast period. Exploration and drilling activity has slowed and some marginal production is being shutin as the price of crude oil falls.

Expansion of Alaskan production is expected to make up for some of the decline in lower-48 output, through 1987. At that point Alaskan North Slope production is expected to begin to fall. And if there is a rapid drop in Alaskan North Slope output then total U.S. domestic crude production might fall even faster than forecast. However, lower-48 production has held up very well in recent years and there may be an extended carry over from the drilling boom. Offshore production for California and Louisiana should help sustain the output level. Total U.S. crude and condensate production is forecast to fall 4.9% by 1990. This is a drop of only 432,000 b/d.

NGL production is expected to be maintained close to the present level of about 1.6 million b/d. There is expected to be a slight decline over the forecast period. However, this is dependent upon the relative economics—the cost of extraction and the market price. Total domestic liquids output is expected to fall 4.6%, 487,000 b/d by 1990, to 10.01 million b/d.

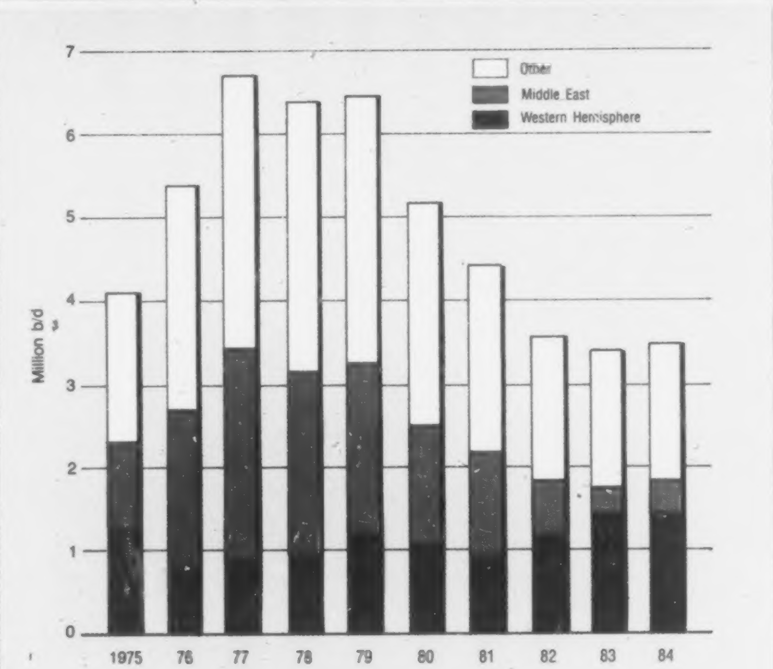
A key indicator of future security of the supply of domestic crude oil is the ratio of proven reserves to production. For domestic crude and condensate this ratio has been declining slowly but steadily since 1972. The ratio has fallen from reserves equal to 10.51 years of production in 1972 to 8.54 years of production in 1984. The drilling boom slowed the decline in 1980 and 1981 as substantial reserves were added. But production has been on the rise in recent years and reserves have been falling. It has been estimated that a massive exploration and drilling effort will have to be launched in order to slow the decline. Replacing reserves is essential to the long term viability of the domestic industry and to U.S. energy security.

With demand increasing over the forecast period and domestic liquids production falling, imports will have to increase to fill the growing gap between domestic supply and demand.

Total imports peaked in 1977 at 8.787 million b/d. As demand fell, imports were reduced, rather than reducing domestic production. Imports fell to 4.948 million b/d in 1983, down 43.7%, a drop of 3.839 million b/d. Demand fell 3.616 million b/d from the peak in 1978 to 1983. All of the decline in demand was reflected in the reduction in imports. In addition the increased domestic production backed out additional imports.

Most of the decline was in crude oil imports, which fell 3.498 million b/d from 6.594 million b/d in 1977 to 3.096 million b/d in 1983, a drop of 53%. Product imports fell 471,000 b/d, 21.5% from 2.193 million b/d to 1.722 million b/d in 1983.

Crude oil imports*



*Includes imported crude for the Strategic Petroleum Reserve.

Source: Energy Information Administration

Stock levels and days' supply

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Stocks: (1,000 bbl)												
Crude oil*	242,478	265,020	271,354	285,471	339,813	309,421	339,080	358,166	363,464	349,730	343,850	343,522
Products	765,829	856,096	855,537	810,417	947,479	896,003	911,784	926,262	889,843	786,367	730,698	761,052
Total	**1,008,307**	**1,121,116**	**1,126,891**	**1,095,889**	**1,287,292**	**1,205,424**	**1,250,864**	**1,284,482**	**1,253,307**	**1,136,097**	**1,074,548**	**1,104,574**
SPR†	—	—	—	—	7,540	58,798	117,687	123,938	230,341	293,827	379,089	450,505
Demand: (1,000 b/d)												
Products supplied	17,308	16,653	16,322	17,461	18,431	18,847	18,513	17,056	16,058	15,296	15,231	15,708
Days Supply:												
Product stocks	44.25	51.41	52.42	46.41	51.41	47.54	49.25	54.31	55.41	51.41	47.97	48.45
Total stocks	**58.26**	**67.32**	**69.04**	**62.76**	**69.84**	**63.96**	**67.57**	**75.31**	**78.04**	**74.27**	**70.55**	**70.32**

*Excluding SPR. †Strategic Petroleum Reserve.

Source: Energy Information Administration

Product imports actually hit bottom in 1981 at 1.599 million b/d and have been increasing since. Both crude and product imports increased in 1984 as demand moved up. This was immediate evidence that increased imports will have to meet all future needs from increased consumption.

It should be noted that product imports have increased substantially from 1981-1984. Product imports moved up 380,000 b/d, an increase of 23.8% since 1981. With excess refining capacity worldwide products are available on the market at extremely economic prices making imports advantageous.

With excess domestic refining capacity domestic refiners should have more incentive to import crude rather than products. This would enable refiners to increase crude runs and lower unit costs. And with the pattern demand relatively uncertain crude imports offer refiners additional flexibility. They can change yield patterns as required by demand. However, with product supplies plentiful on the worldwide spot market flexibility can be retained by simply importing the products required.

Product imports are expected to fall in 1985. But as additional export refineries come on stream in the Middle East and U.S. import requirements increase, product imports are expected to move up over the forecast period.

Import dependency dropped sharply from 1977 to 1983. Total imports as a percentage of domestic demand had risen from 29.1% in 1972 to a peak of 47.7% in 1977. With declining imports this ratio fell to 31.6% in 1983. The rebound in imports in 1984 pushed it back up to 33%.

A third of U.S. oil requirements must be imported. This is expected to move up over the forecast period as additional imports are needed to meet rising demand. U.S. dependency is expected to increase to 41% in 1990.

U.S. vulnerability to a supply disruption has been reduced by a shift in the source of imports. The source of imports has been shifted away from some of the more volatile areas. Crude imports from the Persian Gulf countries have been reduced substantially. Crude imports from that area fell from 2.495 million b/d in 1977 to 438,000 b/d in 1983 and 456,000 b/d in 1984. Imports from the OPEC countries have dropped from 5.643 million b/d in 1977 to 1.477 million b/d in 1983 and 1.497 million b/d in 1984. The percentage of U.S. crude imports from OPEC countries has fallen from 85.7% in 1976 to 44% in 1984.

Non-OPEC crude imports to the U.S. moved up from 952,000 b/d in 1977 to 1.709 million b/d in 1984. Mexico has become the leading source of U.S. imported crude supplying 766,000 b/d in 1983, and 653,000 b/d in 1984. The United Kingdom has become another major source at 372,000 b/d in 1984.

The excess capacity situation in the world crude market has led to a very competitive trading atmosphere in crude oil products. This has resulted in the rapid expansion of "spot market" and the development of a futures market for major products and crude oil. Import transactions are now dominated by spot marketing trading. It is estimated that spot market trades represented about 5% of U.S. total imports in 1977-78. This has risen to over 50% in 1984. The volumes of imported crude and products traded on the spot market has risen from about 450,000 b/d in 1977-1978 to an estimated 2.85 million b/d in 1984, an increase in spot market trading of 2.4 million b/d, 433.3%. In addition to the rapid increase in spot market trading

Crude imports by country of origin

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
	(1,000 b/d)									
Eastern Hemisphere:										
Algeria	264	409	544	634	608	457	261	90	176	193
Angola	71	7	17	6	39	37	45	42	71	85
Egypt	5	17	36	20	55	31	33	40	25	10
Gabon	27	27	35	38	42	25	35	40	59	55
Libya	223	445	704	638	642	549	317	23	—	—
Nigeria	746	1,016	1,130	910	1,069	843	611	510	301	206
Other Africa*	2	42	34	30	42	62	32	30	48	65
Total Africa	**1,338**	**1,963**	**2,500**	**2,276**	**2,497**	**2,004**	**1,334**	**775**	**680**	**614**
Kuwait	4	1	42	5	5	27	—	2	7	24
Oman	1	30	74	61	37	24	24	22	34	10
Qatar	18	24	67	64	31	22	7	7	—	4
Saudi Arabia	701	1,225	1,373	1,142	1,347	1,254	1,112	530	321	306
United Arab Emirates	117	255	333	385	281	173	77	81	18	90
Other Middle East*	281	331	606	623	395	38	6	38	58	22
Total Middle East	**1,122**	**1,866**	**2,495**	**2,280**	**2,096**	**1,538**	**1,226**	**680**	**438**	**456**
Indonesia	379	539	507	533	380	315	318	226	315	303
Malaysia	5	16	55	37	55	61	33	18	3	—
Other Far East*	—	—	—	—	—	1	—	11	7	40
Total Far East	**384**	**555**	**562**	**570**	**435**	**377**	**351**	**255**	**325**	**343**
Norway	12	35	48	104	75	144	114	102	65	112
United Kingdom	1	13	97	169	197	174	369	441	365	372
Other Europe*	4	1	5	10	8	—	—	—	3	3
Total Europe	**17**	**49**	**150**	**275**	**280**	**318**	**483**	**543**	**433**	**487**
Other Eastern Hemisphere†	—	2	8	8	3	—	37	54	91	121
Total Eastern Hemisphere	**2,861**	**4,435**	**5,715**	**5,409**	**5,311**	**4,237**	**3,431**	**2,307**	**1,967**	**2,021**
Western Hemisphere:										
Brazil	—	—	—	—	—	1	14	19	2	—
Ecuador	56	51	55	38	30	17	38	22	56	47
Mexico	70	87	177	316	436	508	469	645	766	653
Peru	—	—	—	18	40	41	30	21	8	1
Trinidad-Tobago	—	—	—	—	—	115	102	92	83	87
Venezuela	395	241	250	181	293	156	147	155	164	247
Other Latin America*	—	—	1	2	—	3	—	—	4	1
Total Latin America	**521**	**379**	**483**	**555**	**799**	**841**	**800**	**964**	**1,083**	**1,036**
Canada	600	372	279	248	271	200	164	214	274	343
Other Western Hemisphere†	122	115	138	144	124	—	1	3	5	3
Total Western Hemisphere	**1,243**	**866**	**900**	**947**	**1,194**	**1,041**	**965**	**1,181**	**1,362**	**1,382**
Total Crude Imports	4,104	5,301	6,615	6,356	6,505	5,278	4,396	3,488	3,329	3,403
Less: SPR Imports	—	—	20	162	67	44	256	165	234	197
Crude Imports (ex. SPR)	4,104	5,301	6,595	6,194	6,438	5,234	4,140	3,323	3,095	3,206
OPEC Imports	3,211	4,545	5,643	5,184	5,112	3,864	2,922	1,734	1,477	1,497
% OPEC Imports	78.2%	85.7%	85.3%	81.6%	78.6%	73.2%	66.5%	49.7%	44.4%	44.0%

*May include data on countries listed specifically but for which no individual data are reported
†Includes data which could not be broken down by country or continent
Source: Energy Information Administration

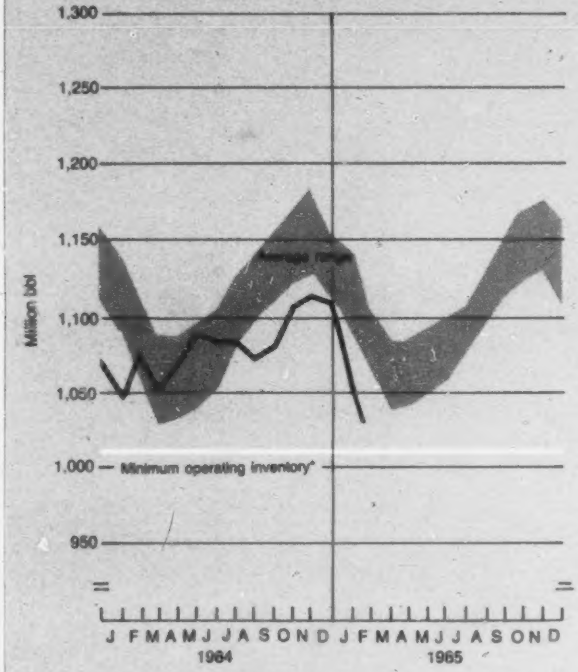
New York Mercantile Exchange

Total Annual Contract Volumes
Thousand contracts
(million barrels)

Year	Total oils	Heating oil	Leaded gasoline	Crude oil	Unleaded gasoline
1978	50	50	—	—	—
1979	100	100	—	—	—
1980	240	240	—	—	—
1981	1,010	950	60	—	—
1982	1,850	1,725	125	—	—
1983	2,625	1,850	425	350	—
1984	4,650	2,100	650	1,850	50

Source: New York Mercantile Exchange

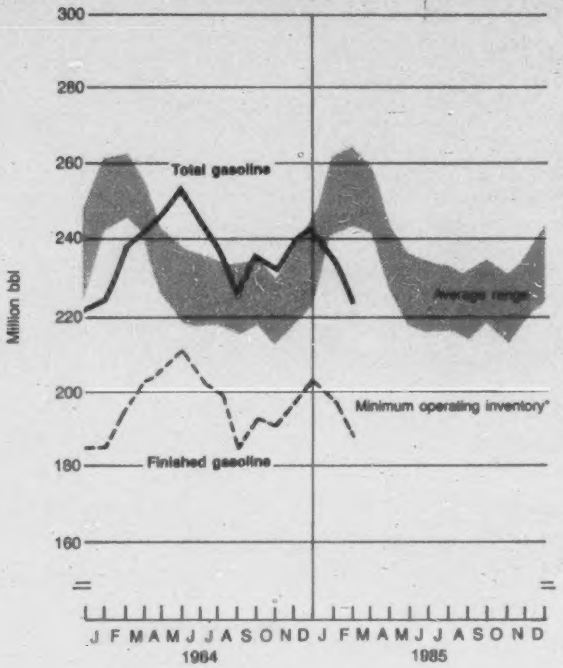
Crude oil & pet. prod.



*Excludes stocks for Strategic Petroleum Reserve

Source: Energy Information Administration

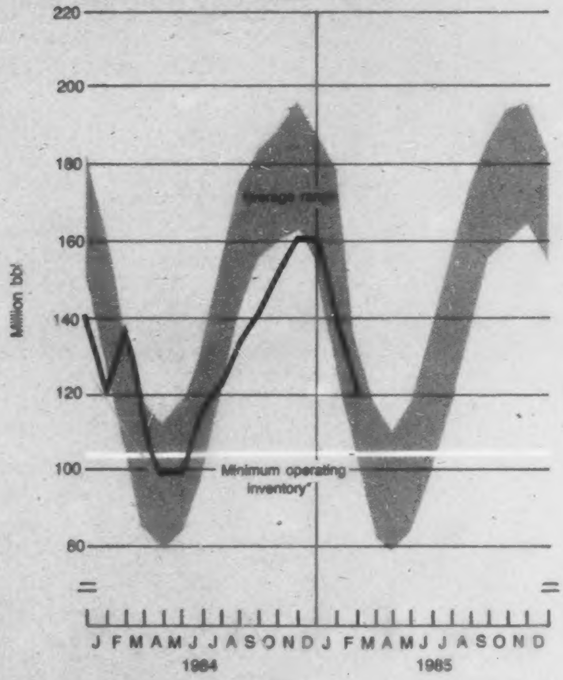
Motor gasoline



*National Petroleum Council estimate

Source: Energy Information Administration

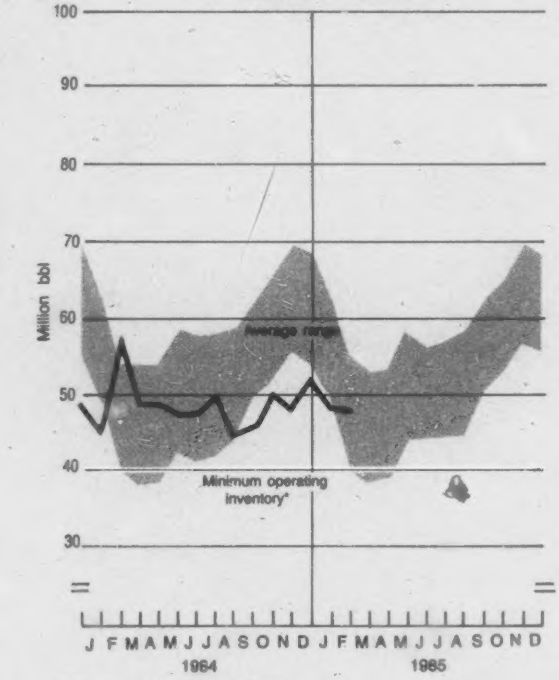
Distillate fuel oil



*National Petroleum Council estimate

Source: Energy Information Administration

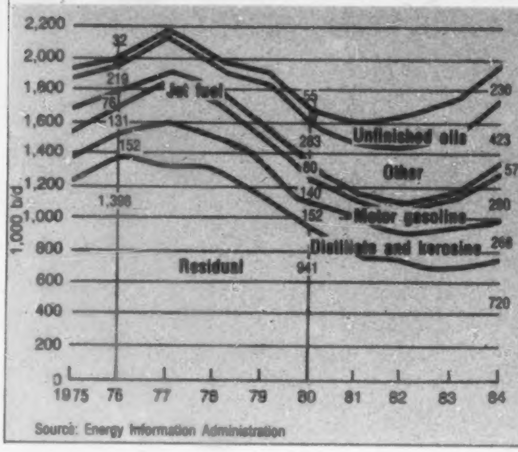
Residual fuel oil



*National Petroleum Council estimate

Source: Energy Information Administration

Refined product imports



Source: Energy Information Administration

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
	1,000 b/d									
Gasoline	184	131	215	190	181	140	157	197	247	290
Kerosine	3	9	19	11	9	10	7	13	11	8
Jet fuel-kerosine	105	61	83	67	55	49	31	23	29	45
Jet fuel-naphtha	29	15	21	19	22	31	7	5	1	12
Distillate	155	143	249	173	196	142	173	93	174	280
Residual	1,223	1,398	1,350	1,355	1,150	941	640	778	699	720
Unfinished oils	38	32	31	27	56	55	112	174	234	230
Other*	217	219	238	165	254	256	312	344	327	423
Total U.S.	1,951	2,008	2,176	2,007	1,593	1,651	1,599	1,625	1,722	1,988

*Includes plant condensate: 1975, 74; 1976, 67; 1977, 41; 1978, 17; 1979, 17; 1980, 10; 1981, 7; 1982, 17; 1983, 6; 1984, 25.

Source: Energy Information Administration

Spot market volumes

Year	U.S. Imports (Thousand barrels per day) Total Industry Imports	Fixed Price Contract	Spot Market
1975	6,056	5,871	185
1976	7,313	7,018	295
1977	8,786	8,346	440
1978	8,201	7,751	450
1979	8,389	7,884	505
1980	6,866	6,386	480
1981	5,740	5,165	575
1982	4,948	3,958	990
1983	4,817	2,887	1,930
1984	5,276	2,366	2,910

Note: Spot market volumes include for 1983 and 1984 contract volumes where the price is directly related to spot market prices and fluctuates with the spot market prices. This might be more aptly labeled "volumes traded on the spot market and at market related prices."

Source: DOE and Author's estimates

many of the contract traders are now influenced by the spot market. The price arrangements of contracts are flexible and related to current stock market transactions.

The increase in spot market trading and the fluctuation in prices introduced an element of risk into crude and product trading that did not exist in the past. This has led to the development of a futures market for major petroleum products and for crude oil. Heating oil futures were first introduced in 1978. Total annual contract volumes on the New York Mercantile Exchange have risen from 50,000 contracts in 1978 (50 million b/d) to 4,650,000 contracts in 1984 (4.65 billion bbl). The futures market has become a major influence in determining spot market prices.

Stocks of petroleum products and crude oil are another source of supply. Total crude and product stocks, excluding stocks for the strategic petroleum reserve (SPR), fell 210 million bbl from year end 1980 to year end 1983. This added an average 192,000 b/d to available supply over that three year period. Stocks went up marginally, 30 million bbl, in 1984 as demand increased.

Prior to 1981, the industry was willing to build up stocks as a buffer against a potential supply disruption. There was also uncertainty about the extent of the drop in demand. Stocks were maintained at a relatively high level in anticipation of demand going back up.

As stock carrying costs increased with the high interest rates, it became imperative that stocks be reduced. A concentrated effort was made to reduce stocks to a level consistent with demand.

The U.S. Energy Information Administration has developed a system of tracking stocks and determining their adequacy. The system is based on historical stock levels and indicates the historical average range of product and crude stocks and the minimum operating inventory. Theoretically if stocks fall below the minimum level there is a danger of supply disruption. However, recently stocks for a number of products have fallen below the average range and below or close to minimum operating levels. It appears that the industry is adjusting so rapidly to reduced demand levels that some of these measurements are no longer totally valid.

As refining capacity is reduced and distribution networks altered, the minimum operating inventory is also reduced. And the average range will be adjusted downward to reflect the lower level of demand.

The preferred way to determine the adequacy of stocks is to measure them in terms of days' supply. Total stocks represented 58 days' supply in 1973. This increased to 78 days at yearend 1981. After the sharp reduction in stocks, there was some concern about the adequacy of stock levels, but stocks at yearend 1984 still represent over 70 days' supply at the reduced demand level of 1984. Stocks could probably be reduced even further and still provide adequate backup for the expected levels of demand.

But it is more likely that stocks will be retained at present levels. Further adjustment will require some additional adjustment to the refining and distribution network. This will take some time.

Crude oil stocks in the Strategic Petroleum Reserve (SPR) surpassed industry crude oil stocks in July 1983. At year end 1984 SPR stocks were 451 million bbl and industry stocks 344 million bbl. Due to budget constraints it is anticipated that additions to the SPR may be suspended in 1985. The total SPR stock level at that time would be almost 500 million bbl. The SPR does provide some backup in case of emergency. But no procedure has been established for using SPR crude so it is doubtful that it greatly influences industry stock decisions. At present demand levels the SPR stock represents only about 30 days supply.

THE OUTLOOK — U.S. SUPPLY

	1985	1986	1987	1988	1989	1990	Change 1985 to 1990	% change 1985 to 1990
PETROLEUM BALANCE (thousand barrels/day)								
DEMAND:								
Domestic demand	15,842	15,980	15,985	16,380	17,030	17,540	+1,698	+10.7
Exports	755	750	700	650	680	700	− 55	− 7.3
Total demand	**16,597**	**16,730**	**16,685**	**17,030**	**17,710**	**18,240**	**+1,643**	**+ 9.9**
SUPPLY:								
Crude production	8,842	8,760	8,675	8,585	8,505	8,410	− 432	− 4.9
NGL production	1,655	1,650	1,630	1,620	1,600	1,600	− 55	− 3.3
Total liquids	**10,497**	**10,410**	**10,305**	**10,205**	**10,105**	**10,010**	**− 487**	**− 4.6**
Crude imports	3,608	3,800	3,840	4,290	5,020	5,540	+1,932	+53.5
Product imports	1,745	1,760	1,760	1,805	1,875	1,930	+ 185	+10.6
Total imports	**5,353**	**5,560**	**5,600**	**6,095**	**6,895**	**7,470**	**+2,117**	**+39.5**
Other supply	775	780	775	790	820	840	+ 65	+ 8.4
Total supply	**16,625**	**16,750**	**16,680**	**17,090**	**17,820**	**18,320**	**+1,695**	**+10.2**
TOTAL STOCKS (million barrels)	1,541	1,566	1,583	1,623	1,681	1,728	+ 187	+12.1
Industry stocks	1,058	1,065	1,063	1,085	1,125	1,154	+ 96	+ 9.1
Crude stocks	350	350	348	352	355	360	+ 10	+ 2.9
Product stocks	708	715	715	733	770	794	+ 86	+12.1
SPR stocks	483	501	520	538	556	574	+ 91	+18.8
CRUDE OIL PRICE (U.S. wellhead price) ($/barrel)	$24.25	$23.10	$21.30	$21.00	$21.75	$22.20	−$2.05	− 8.5

Capital Expenditures

Capital Expenditures

THE SLIDE in oil prices since early 1981 and the recent leveling of gas prices has reduced total funds available to the U.S. oil and gas industry for reinvestment. The level of total capital and exploration expenditures in the U.S. oil and gas industry is closely related to the level of funds available. And as a result U.S. oil capital and gas industry capital and exploration expenditures plummetted from the lofty levels of the 1981 and 1982 peak boom years.

Lower prices coupled with lower demand levels for both oil and gas to substantially reduce total wellhead revenues. In addition, the shift from "boom" to "bust" in the industry left a number of companies burdened with a heavy debt load. And this problem, along with somewhat pessimisstic near term prospects for prices, have sharply reduced the flow of outside capital into the industry.

Although the economics of exploration and production has improved, offering a greater profit potential, the glamor is off of oil investing. Outside capital flowed into the industry in anticipation of oil prices moving up rapidly in the 1980's. The outlook calls for prices to drop slightly in the near future and to rise only moderately over the long run.

Although investing in the industry may actually be more economically profitable now than in the boom periods, expectations have been sharply diminished by the fall in prices. And, the highly speculative funds that flowed into the industry in the 1979-1982 period, in anticipation of a potential high rate of return, are now being invested elsewhere.

The expectation of higher oil prices not only increased the flow of outside capital but also encouraged a number of companies to increase their debt of expansion. As prices fell the debt became a prohibitive burden. The necessity to repay the debt with funds from lower valued oil has severely restricted the investment capability of many firms. For the industry as a whole, this has resulted in a wellhead revenue reinvestment ratio at very low levels.

In addition, the majority of oil companies have been forced into reorganization to prevent hostile takeovers and dismemberment. The fall in prices and oil company revenues rapidly changed the perception outside investors had of the future potential of the oil industry. Most of the companies had been restructuring since the peak period by cutting costs and shedding surplus facilities. However, outside interests saw a profit opportunity in forcing rapid

U.S. capital spending

	1977	1978	1979	1980	1981	1982	1983	1984	1985
	(million dollars)								
Drilling-Exploration	14,172	15,079	21,926	31,789	43,193	40,965	28,193	29,917	27,430
Production	2,659	3,132	4,490	6,191	7,984	7,144	5,531	5,919	5,375
OCS Lease Bonus	1,569	1,767	4,590	4,205	6,599	3,800	5,749	4,037	1,960
Subtotal	**18,400**	**19,978**	**31,006**	**42,185**	**57,776**	**51,909**	**39,473**	**39,873**	**34,765**
Refining	1,324	1,551	2,735	3,159	5,131	5,775	4,142	3,075	3,184
Petrochemicals	1,746	2,675	2,355	2,805	2,792	2,031	1,112	1,215	1,524
Marketing	687	982	851	1,276	1,619	1,349	1,614	2,253	2,384
Crude & Products Pipelines	1,630	989	1,509	1,777	2,052	1,121	2,456	1,689	1,137
Gas Pipelines	873	809	1,491	3,642	4,947	5,179	4,707	3,971	2,084
Other Transportation	438	468	583	804	895	515	456	386	421
Miscellaneous*	1,593	1,738	3,700	5,022	7,731	7,760	4,567	4,724	4,347
Subtotal	**8,291**	**9,212**	**13,224**	**18,485**	**25,167**	**23,730**	**19,054**	**17,313**	**15,081**
Total	**26,691**	**29,190**	**44,230**	**60,670**	**82,943**	**75,639**	**58,527**	**57,186**	**49,846**

*Includes mining and other energy

Source: Oil & Gas Journal 1977-1985

restructuring. This has resulted in a wave of mergers, stock repurchase plans and other moves to fend off hostile takeovers. The result for most companies has been a substantial increase in debt. This has further reduced funds available for reinvestment.

Capital spending by U.S. oil companies peaked in 1981 at $82,943 million. It fell to $75,639 million in 1982 and then dropped sharply to $58,527 million in 1983. Spending dropped marginally in 1984 to $57,186 million. Capital and exploration spending is estimated to be down 12.8% in 1985 to $49,846 million. The 1985 level of outlays is down 40% from the peak in 1981.

The oil and gas industry tends to lag the overall economic cycle. The industry did not peak until after the economy began to slow. Likewise, the industry will lag the economy on the upswing.

In the face of lower prices and demand, firms have been cutting costs to help their profit picture. As the effects of the cost cutting begins to show up in improved profit, investment will respond. In addition, as the companies reduce the heavy debt load, investment can be increased. The lower debt load and improved profits also will attract outside funds into the industry.

However, it is not expected that there will be anything close to the surge in spending that occurred during the 1980-1982 period. Instead, capital expenditures will closely follow revenue and price movements, economic activity, and energy and oil demand.

The level of capital spending does not appear to rise and fall along with the level of company profits. However, the direct relationship between capital investment and profits does fluctuate.

For the Oil & Gas Journal group of about 25 oil companies, worldwide capital and exploration expenditures as a percentage of net income ranged from 177.5% in 1980 to 261.5% in 1982. The average from 1977 through 1984 was 219.3%. In 1984 spending was 232.3% of net income for this group of companies.

This same group of large companies has maintained a high level of capital investment relative to profits despite the downturn in the industry. Their planning horizons tend to be relatively long range and they are investing in future returns. This longer range outlook is contrary to present investment market philosophy. However, after some restructuring, it is an investment philosophy that may pay large future returns.

U.S. domestic expenditures for exploration and production activities will tend to follow the pattern of movement of oil prices over the forecast period. Spending in this area will drop 12.8% to $34.8 billion. This is done from $39.9 billion in 1984.

Activity will not drop as sharply as indicated by these figures. Of the $5.1 billion drop in outlays, $2.1 billion is in OCS lease bonus payments. The drop in drilling, exploration and production, excluding OCS bonus payments, is $3 billion, a decline of 8.5%.

Drilling and exploration expenditures will drop to $27.4 billion in 1985 from $29.9 billion the year before, a decline of $2.5 billion, 8.3%. Production equipment outlays will drop 9.2% to $5.4 billion in 1985 from $5.9 billion in 1984. Sliding oil prices and uncertainty concerning taxes related to investments in the oil industry, have had an impact on investment in this sector. The independent sector of the industry relies heavily on outside investment funds. Anything that discourages investment returns in the oil industry has an adverse impact on exploration and drilling activity and investment. With continuing uncertainty, many exploration, drilling and production budets have been trimmed.

Total exploration and production outlays will remain close to the 1985 levels through 1988 and then begin to move up toward the end of the forecast period. Increased demand will begin to push up prices and attract additional investment and boost spending.

Drilling and exploration spending will dip to $26.2 billion in 1987 and then begin to move up, reaching $32.8 billion in 1990. Spending in 1990 will be 19.7%, $5.4 billion above the level of 1985.

The necessity to replace rapidly depleting domestic oil and gas reserves will become obvious. Expectations are that some stimulus will be provided to encourage exploration and drilling. Well completions should also move up substantially. Increased productivity coupled with increased investment should boost well completions sharply, although this will be somewhat offset by increased activity in remote areas and increased deep drilling.

Drilling costs will begin to move up again toward the end of the forecast period. By that time all of the surplus in the service and supply industry will have been worked off.

Outlays for production facilities will follow a similar pattern over the forecast period. Spending will drop 3.4% from 1985 to 1987, down to $5.2 billion. Spending will then move up, reaching $6.4 billion in 1990.

Spending for OCS lease bonus payments is expected to rebound in 1986 to $2.6 billion. It is expected that the government will develop a consistent long range strategy for offering outer continental shelf properties for lease. Property will become available as it is evaluated and the industry can absorb its development. Spending in this area will increase in 1989 and 1990 as prices begin to move up, as the economics of the individual properties change, and as companies increase cash flow for bidding.

Spending on downstream facilities and other projects will decline in 1985 for the fourth consecutive year, to $15.1 billion. This is a drop of 12.9% from 1984, down $2.2 billion. Spending in this category peaked in 1981 at $25.2 billion. Outlays in 1985 are down 40.1% from that peak, a drop of $10.1 billion.

However, it is expected that this will be the low point of the forecast period. Restructuring in the industry will require that the spending be maintained even though prices will be sliding for a couple of years. And spending will move up as prices and demand move up in 1988-1990.

Spending in this category will increase slightly and be up 0.9% at

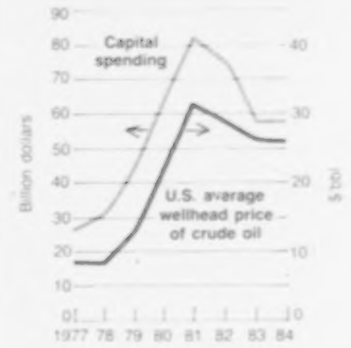
OGJ group* profits and capital spending

	Net income (Million $)	Capital & exploratory expenditures (Million $)	Capital & exploration expenditures % of net income
1977	12,550.0	26,811.0	213.6
1978	13,779.0	42,265.0	306.7
1979	23,130.0	53,261.0	230.3
1980	29,326.8	52,065.0	177.5
1981	28,205.4	66,895.8	237.2
1982	23,079.7	60,357.0	261.5
1983	22,325.5	45,584.1	204.2
Total 1977-1983	152,396.4	347,238.9	227.9

*Oil & Gas Journal group of 25-28 major oil companies.

Source: Oil & Gas Journal.

Capital spending and U.S. wellhead crude prices



Source: Oil & Gas Journal; Energy Information Administration.

International spending – U.S. firms

	1981	1982	1983	1984	1985
			$ million		
Exploration-Production					
Drilling-Exploration	5,863	6,722	5,622	5,481	5,435
Production	3,156	3,570	2,940	2,711	4,356
Subtotal	9,019	10,292	8,562	8,192	9,791
Other					
Refining	1,170	781	606	892	947
Petrochemicals	436	602	467	405	354
Marketing	794	666	638	583	706
Pipelines	132	131	141	147	64
Other transportation	274	250	152	125	118
Mining & other energy	677	805	869	1,087	1,142
Miscellaneous	584	415	650	293	316
Subtotal	4,062	3,650	3,623	3,554	3,685
Total	13,081	13,942	12,185	11,746	13,476

$15.2 billion in 1987. Capital outlays will then increase more rapidly reaching $16.6 billion in 1990, up $1.4 billion, 8.9%, from 1987.

Refining investment has remained at relatively high levels even though demand fell for five consecutive years, 1978-1983. And outlays are expected to remain at present levels in 1985. This spending level appears contradictory in the face of slim refining margins and plant shutdowns. But continued high levels of investment are essential for improved profitability. Refiners are cutting back on overall distillation capacity but are continuing investments in upgrading programs. Further profitability lies in increased yields of higher priced light products and the ability to use heavier, cheaper crudes. The refining industry continues to look for ways to reduce their own energy use.

The refining sector is still faced with an overcapacity problem and additional shutdowns can be expected. The impact of increased competition from new foreign refineries has not been determined. Though there is substantial overcapacity in the U.S. and worldwide, several new refineries have been added in the OPEC countries.

Spending by U.S. oil companies on refining and petrochemical facilities is expected to be up in 1985 to $4.7 billion, an increase of 9.7%. Spending in the refining sector is estimated at $3.2 billion in 1985, up 3.5%. Refining outlays are down 44.9% from the peak in 1982 but still much higher than during this period prior to 1980.

Petrochemical outlays will move up to $1.5 billion in 1985 from $1.2 billion in 1984. Most of the investment will be for modernization and conservation of raw materials in order to cut unit costs and remain competitive. Petrochemicals were burdened with overcapacity, particularly during the recession. The economic upswing should help improve profitability. However, the industry is faced with increased competition overseas. Producing countries are investing in new facilities with the feeling that being located close to the source of the feedstocks gives them a competitive edge. Plants in the industrial countries are countering this by improving technology and reducing costs.

Spending for downstream activities is expected to remain close to 1985 levels through 1987. During this period spending will be dedicated to maintaining profitability and market share in an industry in flux. In the latter part of the forecast period spending will also be directed to some expected expansion in the industry.

Transport spending, principally for pipelines, will follow a similar pattern. Spending will drop slightly, 1.2% to $3.6 billion in 1987 and then begin to move up again with increased activity.

Pipeline spending in 1985 is estimated at $3.2 billion. This is down 43.1% from 1984 and the lowest level since 1979. Spending for natural gas pipelines fell an estimated 47.5% in 1985 to $2.1 billion and crude and product pipelines down 32.7% to $1.1 billion.

Capital spending for marketing facilities is expected to continue to move up throughout the forecast period. The high level of competition in the marketing sector has stimulated investment as companies strive to maintain and/or gain market share. Spending is expected to move up 17% to $2.8 billion in 1990.

Spending by U.S. oil companies for mining and other activities was down sharply in 1985 to $4.3 billion, a drop of 8% from 1984. This is down $3.4 billion, 44% from the peak in 1982. Spending in this area is expected to move up more moderately over the forecast period than other categories of spending. A number of companies have sold or discontinued their mining and metals operations.

International expenditures by a sampling of U.S companies indicates that overseas investment will be up in 1985. Spending plans for this group call for total overseas outlays of $13.5 billion in 1985, up 14.7% from 1984 and close to the $13.9 billion in 1982.

International expenditures are not as volatile. They are outlays by the larger international companies and for longer term projects. But continued investment does indicate a "business as usual" attitude. This is reassuring in an industry that is still passing through a major transition.

The increase is due primarily to a sharp increase in drilling, exploration and production spending. Outlays in this area will move up 19.5% to $9.8 billion in 1985. The companies continue to go all out in their efforts to find equity crude in non-OPEC areas of the world.

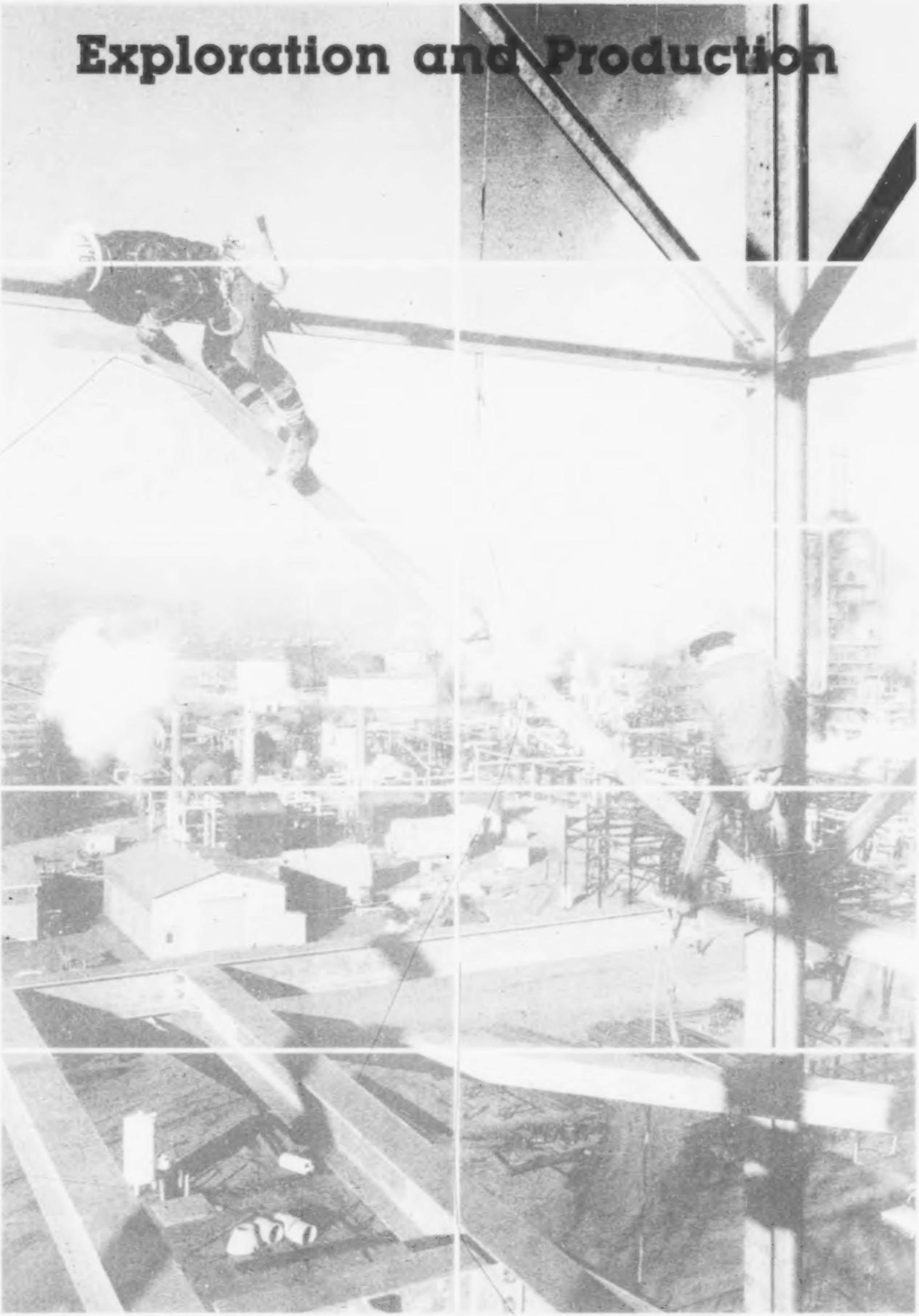
Downstream and other investments will be up only marginally in 1985, increasing 3.7% to $3.7 billion.

A major adjustment is taking place in the refining, petrochemical, and marketing segments of the oil industry. With slow economic growth and demand for energy, the industry is faced with a huge overcapacity problem. This will have to be sorted out before investment in downstream activities increases.

THE OUTLOOK — CAPITAL EXPENDITURES

	1985	1986	1987	1988	1989	1990	Change 1985 to 1990	% change 1985 to 1990
U.S. DOMESTIC SPENDING: ($ million)								
Drilling & Exploration	27,430	27,385	26,225	27,030	29,935	32,845	+5,415	+19.7
Production	5,375	5,340	5,190	5,295	5,835	6,435	+1,060	+19.7
OCS Lease Bonus	1,960	2,565	2,455	2,530	2,800	3,070	+1,110	+56.6
Subtotal	**34,765**	**35,290**	**33,870**	**34,855**	**38,570**	**42,350**	**7,585**	**+21.8**
Refining & Petrochemicals	4,708	4,765	4,750	4,895	5,090	5,235	+ 527	+11.2
Marketing	2,384	2,445	2,455	2,530	2,690	2,790	+ 406	+17.0
Transport	3,642	3,660	3,600	3,700	3,780	3,840	+ 198	+ 5.4
Mining & Misc.	4,347	4,405	4,415	4,480	4,620	4,710	+ 363	+ 8.4
Subtotal	**15,081**	**15,275**	**15,220**	**15,605**	**16,180**	**16,575**	**1,494**	**+ 9.9**
Total Spending	**49,846**	**50,565**	**49,090**	**50,460**	**54,750**	**58,925**	**9,079**	**+18.2**

Exploration and Production



Exploration & Production

NOWHERE is the boom-bust experience in the oil industry more evident than in the U.S. drilling industry. The sharp drop in oil prices has had a very severe impact on U.S exploration and drilling activity. Although the turnaround in drilling activity lagged in the turnaround in crude oil prices, the relationship is quite evident.

The number of active rotary drilling rigs increased from an annual average of 976 rigs in 1971 to a peak of 3,970 rigs in 1981. This was an increase of 2,994 active rigs, 306.8%. The size of domestic drilling quadrupled over that eleven year span. The weekly count actually peaked at 4,530 active rigs the last week of December 1981.

But then the rig count fell precipitously. The active rig count fell for ten consecutive months hitting a 1982 low of 2,379 in October and averaging 3,105 active rigs for the year. There was a slight seasonal upturn at the end of the year but the count continued its decline. The number of active rigs fell to 1,807 in April 1983, 2,723 rigs lower than the peak, a drop of 60.1%. The annual average for 1983 was 2,232 active rigs, down 1,738 rigs, 43.8% below the peak.

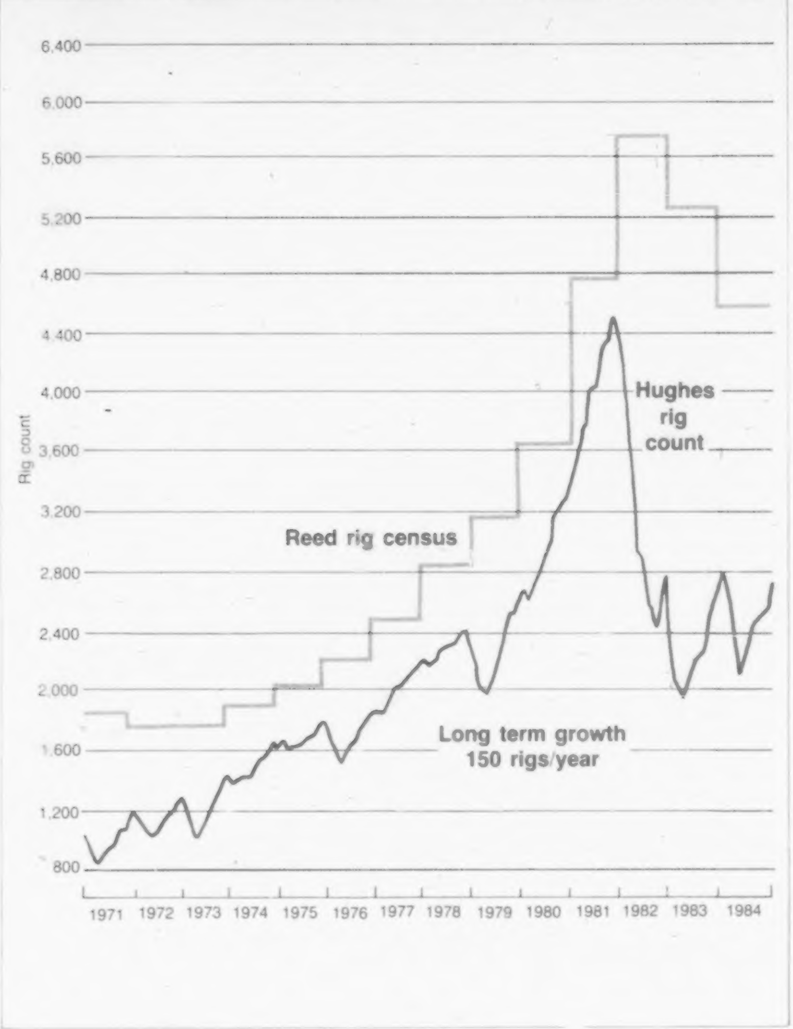
It was the drop in crude oil prices and the sharp shift in the long range outlook for oil prices that led to the downturn in drilling activity. During the 1980-82 drilling boom, expectations that crude oil prices would soon reach $50/bbl and would continue to climb stimulated a surge in drilling activity. With an industry consensus supporting this outlook for higher prices, investment funds flowed into the drilling industry and banks actively sought investors in oil exploration projects. The funds were available for investing, and analysis supported investing, even if it required substantial debt.

Prices actually turned around in February and March, 1981. The U.S. refiner acquisition cost of imported crude peaked in February 1981 at $39/bbl. Domestic refiner acquisition cost and wellhead price peaked in March 1981, at $36.97 and $34.70, respectively.

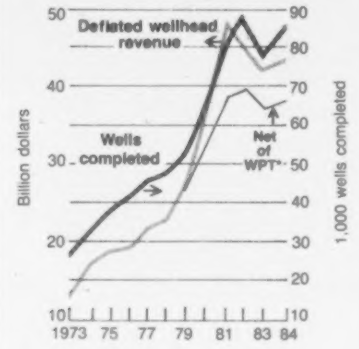
Few analysts or investors picked up on the implications of the turnaround at that early date. Any leveling of prices was considered temporary or regional. Aggregate data prepared by the government was not available. It takes 3-5 months for government agencies to collect, aggregate, and publish ~~the~~ information. And, at the prevailing prices, many projects were still economical. So the drilling boom continued throughout 1981 and into 1982 as crude prices fell.

But many projects were financed based upon expectations of $45-50/bbl oil and a correction proved inevitable. The shakeout from this

The rig fleet and activity



Wellhead revenue and well completions



*Windfall profits taxes

Source: Wells completed, American Petroleum Institute; Wellhead revenue, author's estimates

Well completions, footage, and active rigs

	Active rigs	Total well completions*	Total footage* (1,000 ft)	Average ft./well	Avg. wells per rig	Avg. ft. per rig (1,000 ft)
1973	1,195	27,602	138,937,944	5,034	23.10	116.266
1974	1,471	32,893	153,164,191	4,656	22.36	104.122
1975	1,660	39,097	178,505,570	4,566	23.55	107.533
1976	1,656	41,455	185,344,695	4,471	25.03	111.923
1977	2,001	46,479	215,010,591	4,626	23.23	107.452
1978	2,255	48,513	231,383,981	4,770	21.51	102.609
1979	2,176	51,263	243,207,903	4,744	23.56	111.768
1980	2,910	64,628	294,333,000	4,554	22.21	101.145
1981	3,970	80,537	366,249,300	4,548	20.29	92.254
1982	3,105	88,101	401,459,415	4,557	28.37	129.294
1983	2,232	78,542	330,822,930	4,212	35.19	148.218
1984	2,428	84,183	353,655,326	4,201	34.67	145.657

*Includes service and stratigraphic wells and core tests

Source: American Petroleum Institute and Hughes Tool Co overly optimistic period is continuing. Much of the decline in actual drilling activity is because of financial problems. The actual economics of drilling may be better than they were in 1981 but many companies have a huge debt burden to service and can't take advantage of today's improved economics. Prospects for near future appreciation of the value of crude oil have diminished considerably. Therefore, a great deal of outside investments have diminished. Part of the boom was financed by speculative investing. But that money tends to chase the highest expected rate of return. And so most of that investment money has moved away from the petroleum industry.

Although the rig count has fallen sharply, the number of well completions continues to exceed by far, years prior to 1980. The total number of new well completions reported moved up from 27,300 in 1971 to 88,101 in 1982. This was an increase of 222.7%, compared to an increase in rig activity of 306.8%. One of the major reasons for the difference is the lag between actual well completions and when they are reported and recorded as completed. As the level of drilling activity moved up to record levels, the number of actual new well completions exceeded the ability of state agencies to record and report this information. This lag in reporting distorted the relationship between rig activity and well completions.

A study by the American Petroleum Institute (API) has established some accurate well completion data. This was accomplished by recording historical well completions in the year of actual completion rather than the year reported. According to this study, well completions peaked in 1981 at close to 91,600 wells.

From the 1982 peak, reported well completions have fallen from 88,101 to 78,542 in 1983, and 84,183 in 1984. Estimated actual completions for these years are 74,200 in 1983 and 77,800 in 1984. Based on these estimates, actual completions in 1983 were down 19% from the peak and in 1984 were down 15.1%. The rig count was down 43.8% in 1983 from the 1981 peak and off 38.8% in 1984. Well completions have held up quite well compared to the sharp drop in rotary rig activity.

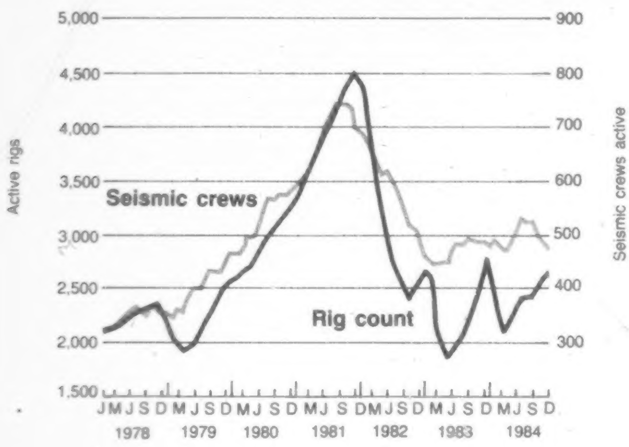
One of the major reasons for this disparity may be the lack of statistical data covering all rig activity. The Hughes Tool Company weekly survey of rig activity records rotary rigs with the drilling depth capability of greater than 2,500 feet. Many, if not most of the shallower wells are drilled with other types of rigs which are not counted in this weekly survey. Since shallower wells are far less costly, the drop in oil prices may not have had as big an impact on their activity. Therefore a large percentage of the shallower drilling activity has continued during the downturn in the drilling industry.

The 1985 active rig count is forecast to average about 2,125 to 2,185. This is down slightly from 2,232 average rigs in 1984. The lower rig count is due mainly to lower actual and expected crude prices and the threat of tax revisions that may have an adverse impact on investments in drilling. Present wellhead revenues can support a higher rig count but the poor price and investment expectations coupled with the heavy debt burden left over from the boom days have held down activity.

Well completions in 1985 are expected to fall to 76,325 from reported completions of 84,183 in 1984. This 9.3% drop is due in part to the drop in rig activity and part a result of the reporting lag.

One of the best indicators of future rig activity is the level of seismic crew activity in the United States. Seismic crew activity peaked in September, 1981, at 744 total crews. This was 3 months

Active rotary drilling rigs and seismic crews



U.S. producing wells

	1976	1977	1978	1979	1980	1981	1982	1983	1984*
Producing Wells: (Dec. 31)									
Oil wells	499,110	507,034	516,752	531,395	547,717	557,009	580,142	603,290	629,385
Gas wells	137,443	148,018	157,454	169,891	182,004	198,839	210,753	214,354	221,059
	636,553	**655,052**	**674,206**	**701,286**	**729,721**	**755,848**	**790,895**	**817,644**	**850,444**
Well completions:									
Oil wells	17,059	18,912	17,775	19,383	27,026	37,671	40,301	37,207	41,095
Gas wells	9,085	11,378	13,064	14,681	15,730	17,894	18,952	15,628	15,705
Net abandonments:									
Oil wells	18,282	10,988	8,057	4,740	10,704	28,379	17,168	14,059	15,000
Gas wells	3,737	803	3,628	2,244	3,617	1,059	7,038	12,027	9,000
	22,019	**11,791**	**11,685**	**6,984**	**14,321**	**29,438**	**24,206**	**26,086**	**24,000**

*Estimates except for completions

Source: API; abandonments calculated by author

Drilling costs*

	Total wells†	Total footage† (1,000 ft)	Total expenditures ($ 000)	Avg. cost per well	Avg. cost per foot
1973	26,244	136,661	3,074,532	117,152	22.50
1974	31,481	150,944	4,366,989	138,718	28.93
1975	36,960	177,642	6,571,214	177,793	36.99
1976	38,941	184,418	7,461,680	191,615	40.46
1977	43,826	212,694	9,956,453	229,181	46.82
1978	46,655	230,619	13,061,090	279,950	56.64
1979	48,523	237,512	16,078,930	331,367	67.71
1980	62,011	296,031	22,800,356	367,682	77.03
1981	80,816	388,800	36,665,456	453,691	94.30
1982	76,652	362,618	39,428,119	514,378	108.73
1983	67,536	301,226	25,104,543	371,721	83.34

*From the Joint Association Survey. †Doesn't agree with other reported figures because based on survey prior to the peak in drilling activity and was one of the early warning signals of the downturn. The number of active seismic crews fell steadily to 447 in March, 1983. This was one month before the rig count hit bottom at 1,846 average active rigs in April. The number of active seismic crews moved up to 498 by October, 1983, an increase of 11.4%. The rig count moved up 38% from April to November, 1983. The seismic crew count fell slightly in early 1984, rose in mid-year and then fell at year-end. The seismic crew count fell sharply during the first half of 1985, leading the downturn in rig activity. It is expected that the seismic crew count will begin to move up late in 1985, signaling an upturn in rig activity.

Over the forecast period the number of active rotary rigs is expected to increase steadily. Increased activity is expected to be stimulated by a number of factors. During the initial years 1986 and 1987 a reduced level of debt will enable producers to direct more of their cash flow to drilling. And the favorable economics, due to substantially lower drilling costs, will attract outside investments.

During the latter part of the forecast period, 1988-1990, rising crude oil and natural gas prices and rising demand for natural gas will help boost domestic drilling activity. The average annual number of active rotary rigs is forecast to reach 2,865 in 1990. This is an increase of 680 active rigs over 1985, up 31.1%.

Well completions are expected to decline for a couple of years through 1987. Lower oil prices are expected to have an impact on drilling for wells with less potential. Therefore non rotary rig drilling is expected to decline in 1986 and 1987 along with the drop in oil prices. This will have an impact on the number of total well completions which is expected to drop to 69,895 in 1987, down 8.4% from 1985. Well completions will then begin to move up throughout the 1988-1990 period. All types of drilling will be stimulated by the higher crude oil and natural gas prices. The number of well completions will move up to 77,455 in 1990, up only 1.5% from 1985 but up 10.8% from 1987. This is far less than what is needed to sustain production but additional activity is highly dependent upon increased prices.

Between 1971 and 1975 the average wellhead price of oil moved up 123% and the rig count increased 70.1%. From 1975 to 1981 the average wellhead price increased 320.2% and the rig count moved up 139.2%. Then from 1981 through 1984 the average wellhead price fell 18.6% and the active rotary rig count fell 38.8%.

What is very noticeable in the well completion and rig statistics is the marked improvement in rig efficiency. The average number of wells per active rig jumped from an average of about 24 over the past ten years to 28.4 in 1982. This moved up to 35.2 wells per rig in 1983 as the rig count plummeted and well completions remained relatively high. It dropped only slightly in 1984 to 34.7 wells per rig as well as completions reported continued to remain high. This ratio is expected to remain high at 34.9 wells per rig in 1984.

Although rig efficiency probably has improved, the actual improvement in productivity is probably marginal when measured annually. Therefore this ratio of wells to active rotary rigs is not truly a measure of efficiency. It is probably more an indicator of the large number of wells drilled with other than rotary rigs. It is expected that this ratio will decline in subsequent years as deeper drilling increases and rotary rig activity increases. The number of wells per active rotary rig is expected to drop to 27 in 1988 and remain at that level throughout the forecast period.

Total wellhead realizations and reinvestment

	Total Wellhead revenues	Net of WPT*	(JAS) Total drilling expenditure	Investment ratio %
1965	10,652,840		2,407,437	22.6
1966	11,429,182		2,360,740	20.7
1967	12,274,468		2,299,178	18.7
1968	12,903,514		2,409,360	18.6
1969	13,882,295		2,610,671	18.8
1970	14,919,586		2,578,682	17.3
1971	15,778,480		2,371,492	15.0
1972	15,886,972		2,814,166	17.7
1973	17,951,977		3,074,532	17.1
1974	28,153,951		4,366,989	15.5
1975	32,061,121		6,571,214	20.5
1976	35,801,316		7,461,680	20.8
1977	41,615,676		9,956,453	23.9
1978	46,562,738		13,061,090	28.1
1979	63,164,966		16,078,930	25.5
1980	97,765,720	87,939,720	22,800,356	25.9
1981	138,947,637	113,105,637	36,665,457	32.4
1982	135,526,277	119,020,277	39,428,119	33.1
1983	124,433,000	111,074,000	25,104,543	22.6
1984E	130,118,000	118,097,000	26,572,000	22.5

E-Estimate. *Windfall profit tax

Source: 1970-1983 API, 1984 Author's estimate

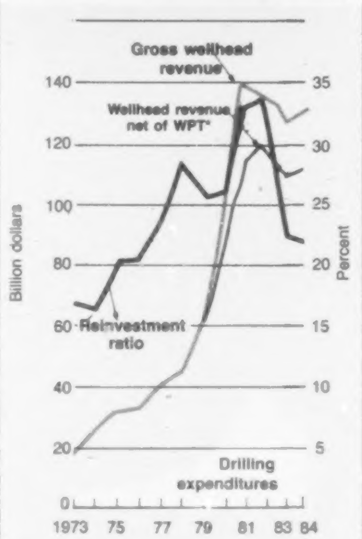
Index of cost of drilling and equipping wells

(1979 = 100)	Weight (%)	1978	1979	1980	1981	1982	1983*
Payments to Drilling Contractors	31.0	77.2	100.0	115.2	140.8	146.7	102.5
Purchased items							
Road site preparation	5.3	90.2	100.0	112.0	120.5	126.6	134.7
Transportation	4.1	90.4	100.0	113.3	124.1	125.4	125.4
Fuel	1.5	73.1	100.0	149.3	181.8	177.5	161.9
Drilling mud and additives	7.1	90.6	100.0	117.1	132.9	137.2	104.6
Well site logging and/or monitoring system	1.5	85.3	100.0	119.8	144.7	148.6	148.6
All other physical tests	0.6	87.3	100.0	112.7	117.0	123.3	123.3
Logs and wireline evaluation services	3.1	88.0	100.0	109.8	127.8	143.6	143.6
Directional drilling services	1.0	87.3	100.0	114.3	120.1	143.0	143.0
Perforate	1.6	89.4	100.0	120.4	140.8	153.8	153.8
Formation treating	4.5	92.1	100.0	120.8	141.6	139.5	130.7
Cement and cementing services	3.7	92.4	100.0	116.8	136.1	144.5	140.4
Casing and tubing	14.6	94.5	100.0	114.8	148.3	158.5	142.4
Casing hardware	0.6	94.5	100.0	114.8	148.3	158.5	142.4
Special tool rentals	3.8	90.3	100.0	108.2	121.5	134.4	134.4
Drill bits and reamers	1.8	90.9	100.0	114.1	130.6	135.9	146.6
Wellhead equipment	2.2	86.4	100.0	121.7	147.1	165.4	157.3
Other equipment and supplies	2.4	90.3	100.0	115.9	138.4	151.9	148.0
Plugging	0.4	92.9	100.0	110.7	127.3	138.6	141.6
Supervision and overhead	2.2	90.8	100.0	110.9	123.0	133.2	138.0
All other expenditures	7.0	88.6	100.0	116.2	128.6	132.1	133.5
Sub-total purchased items	**69.0**	**90.6**	**100.0**	**115.8**	**135.7**	**143.3**	**136.0**
Total†	**100.0**	**86.4**	**100.0**	**115.6**	**137.3**	**144.3**	**125.6**

*Preliminary. †Weighted according to 1982 weights for all years

Source: IPAA

Wellhead realizations and drilling expenditures



*Windfall profits tax

Source: 1970-1982 American Petroleum Institute; 1983, JAS; 1983-1984, Oil & Gas Journal

Total U.S. operating oil wells

	1976	1977	1978	1979	1980	1981	1982	1983	1984
Flowing	32,969	31,815	31,927	34,786	34,529	38,060	36,065	32,994	34,425
Artificial lift	470,299	476,525	484,311	492,069	508,981	518,949	544,077	570,296	594,960
Total	503,268	508,340	516,238	526,855	543,510	557,009	580,142	603,290	629,385

Source: American Petroleum Institute

Also of note is the fact that the average depth of the wells drilled was down sharply in 1983 and 1984 from the depth in the immediately preceeding period. The average depth fell to about 4,553 feet during the years 1980-1982. This was down 3.4% from 4,713 feet per well during the 1977-1979 period. There was then a sharp drop to 4,212 feet per well in 1983, a decline of 7.5%. And the average depth moved down even more in 1984 to 4,201 feet per well. This sharp drop in recent years was due to a shift away from deep gas wells and an increase in shallow oil well drilling. This trend is expected to reverse in 1986 and the average depth is expected to increase throughout the period 1986-1990. The average depth is forecast to increase 6.3% to 4,465 feet per well in 1990. The increase will be mainly due to an increase in deeper gas drilling and somewhat of a slow down in shallower oil well drilling.

Total footage drilled peaked in 1982 at 401.5 million feet. This fell to 330.8 million feet in 1983 and is estimated to drop to 320.5 million feet in 1985. Total annual footage drilled is expected to decline during the first few years of the forecast period. This is due to a shift to deeper drilling that takes longer. Total annual footage is forecast to drop to 305.5 million feet in 1987 and then increase in subsequent years. Total footage will move up along with rig activity and reach 345.8 million feet in 1990.

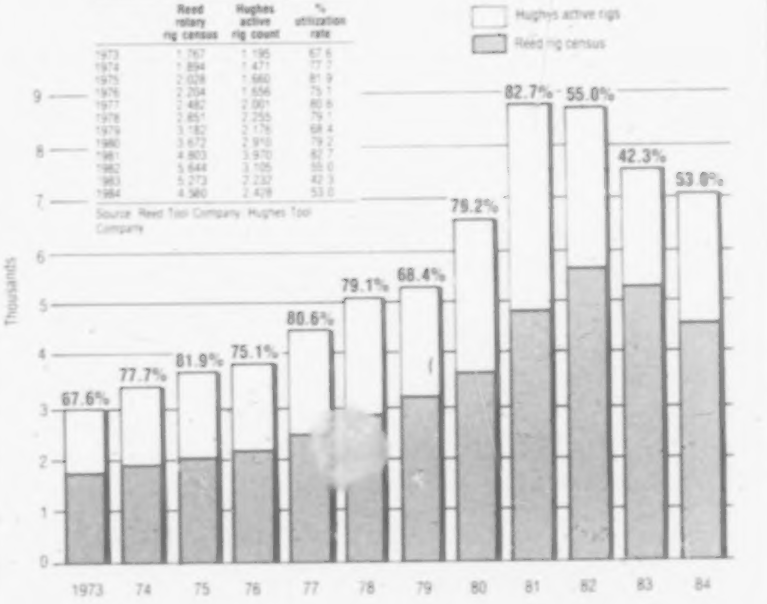
The average footage drilled per rotary rig will follow a similar pattern. Average footage per rotary rig hit a high of 148,268 in 1983. It remained high at 145,657 in 1984 and is expected to average 146,660 in 1985. Again the large volume of non-rotary rig activity has helped boost these figures. Footage per rig will drop to 117,370 in 1988 with the shift to deeper drilling. It will move up slightly to 120,700 feet per rig in 1990. This is still a marked improvement over the period prior to 1982. This long range increase in footage per rig is a better measure of the increased rig efficiency.

The drop in rig activity following the boom was due to both the changing economics of drilling, particularly oil well drilling, and the drop in demand for natural gas. In fact the latter had the more pronounced initial impact on drilling activity. Between 1979 and 1983 demand for natural gas fell 17%. This led to the present gas surplus and a decline in gas well drilling. This was particularly true for deep gas wells, below 10,000 ft. Close to 1,500 of the rigs that were idled were attributed to the decline in deep well drilling. That is close to 75% of the drop in rig activity.

An upturn in rig activity, therefore, is dependent upon the price of oil and the demand for natural gas. These factors will be key determinents of the total wellhead revenues from domestic production. Total wellhead realizations peaked in 1981 at $138,947 million. This was the year of peak oil prices and a relatively high level of demand for natural gas. The windfall profit tax (WPT) took a portion of the revenues available in 1981. Net of this excise tax total wellhead revenues were $113,106 million. In addition to the high level of revenue available, the reinvestment ratio was the highest since 1970 at 32.4%. The reinvestment ratio is the percentage of total revenue available, that are invested in drilling. Total drilling expenditures in 1981 were $36,665 million.

Total wellhead revenues and the reinvestment ratio remained high in 1982. Revenues net of the windfall profit tax totaled $119,020 million with 33.1% reinvested in drilling. Total drilling expenditures were $39,428 million. As oil prices declined and natural gas demand fell total wellhead realizations fell to $111,074 million in 1983, net

Rig utilization



	Reed rotary rig census	Hughes active rig count	% utilization rate
1973	1 767	1 195	67 6
1974	1 894	1 471	77 7
1975	2 028	1 660	81 9
1976	2 204	1 656	75 1
1977	2 482	2 001	80 6
1978	2 851	2 255	79 1
1979	3 182	2 176	68 4
1980	3 672	2 910	79 2
1981	4 803	3 970	82 7
1982	5 644	3 105	55 0
1983	5 273	2 232	42 3
1984	4 580	2 428	53 0

Source Reed Tool Company Hughes Tool Company

Source Reed Tool Co , Hughes Tool Co

Well cost and oil production

Year	Averge cost per well ($)	Wellhead price of oil ($ bbl)	Barrels of oil to cover well cost
1970	94 885	3 18	29 838
1971	94 708	3 39	29 937
1972	106 424	3 39	31 394
1973	117 152	3 89	30 116
1974	138 718	6 74	20 581
1975	177 793	7 56	23 518
1976	191 615	8 19	23 396
1977	229 181	8 57	26 742
1978	279 950	9 00	31 106
1979	331 367	12 64	26 216
1980	367 682	21 59	17 030
1981	453 691	31 77	14 280
1982	514 378	28 52	18 036
1983	371 721	26 19	14 193
1984E	320 000	25 88	12 365

E-Estimate

Source Department of Energy and API 1970-1983 Authors estimates 1984

Total U.S. supply of tubular goods

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Tubular goods (Thous Tons)											
Mill Shipments	1 736	2 261	2 577	1 678	2 405	2 647	2 458	3 612	2 241	1 759	677
Less Exports	198	348	430	169	140	155	285	133	128	67	8
Plus Imports	140	109	217	219	487	591	457	1 036	2 389	2 180	565
U S Supply	1 678	2 022	2 364	1 728	2 752	3 083	2 630	4 515	6 502	3 872	1 234
Footage Drilled (Thous Ft)	138 938	153 164	178 605	185 345	215 010	231 394	243 208	288 936	366 249	401 483	330 823
Tons Tubular Goods Per Thous Ft	12 1	13 2	13 2	9 3	12 8	13 3	10 8	15 6	17 8	9 6	3 7

Source IPAA

of the WPT. In addition the high debt that the industry had accumulated during the peak years had to be financed. This reduced the reinvestment ratio sharply to 22.6% in 1983. Drilling expenditures fell to $25,105 million. Total wellhead revenues moved up in 1984 to $118,097 million net of WPT. Increased natural gas demand was the major reason for the increase. This was partially offset by lower crude oil prices. The reinvestment ratio fell slightly to 22.5%. Total drilling outlays were an estimated $26,572 million in 1984. It should be noted that a portion of the drop in drilling expenditures in 1983 and 1984 was due to lower drilling costs. Therefore the activity level did not drop as much as outlays. In 1985 total revenues, the percentage reinvested, and total drilling expenditures are all estimated to be down from 1984. Total wellhead revenues will be down due to lower crude oil prices. Wellhead revenues net of the WPT will be $115,342 million. The reinvestment ratio will fall to 22%. And total drilling outlays will fall to $25,375 million.

Sliding crude oil prices will result in lower total wellhead revenues in 1986 and 1987. Wellhead revenues will then move up during the 1988 to 1990 period, reaching $116,850 million in 1990.

The cost of drilling has fallen sharply since the peak of the drilling boom in 1981-1982. According to the Joint Association Survey of Drilling Costs, the average cost per well hit an all time high of $514,378 in 1982. It fell sharply to $371,721 in 1983, a drop of 27.7%. The cost continued to slide in 1984 falling to an estimated $316,633 per well, down 38.4% from the peak in 1982. The sharp drop in well costs was primarily due to the competition in the market brought on by the excess capacity and inventory situation. Drilling contractors as well as equipment and service companies came away from the boom period with huge excess inventories and capacities. Prices were slashed in an effort to reduce inventories and use idle capacity. Prices seem to have stabilized in 1984-1985. It is estimated that the average cost per well will move up 5% to $332,465 in 1985.

The average cost of drilling and equipping a new well is expected to rise throughout the 1985-1990 period. A substantial portion of the excess capacity and inventory has been worked off. Therefore increased activity will tend to put some upward pressure on prices. Although price increases will be selective, depending upon the item purchased, the net effects will be rising well costs. The average cost of drilling and equipping a well will move up to $392,230 in 1990. This will be an increase of $59,765 per well, +18%.

An indicator of excess capacity in the industry is the rig utilization rate. The size of the rig fleet moved up with oil prices, increasing from 1,767 rigs in 1973 to 5,644 rigs in 1982. Based on the annual average number of rotary rigs running the rig utilization rate moved up from 52.5% in 1971 to 81.9% in 1975. The rate stayed in the 68% to 80% range from 1976-1980 and moved up to 82.7% in 1981.

The rig fleet was still growing in 1982 as rig activity was falling and the utilization rate plummetted to 55%. The size of the rig fleet fell to 5,273 in 1983 but activity fell faster and the utilization rate dropped to 42.3%. The total rig fleet fell to 4,580 in 1984 and the utilization rate moved up to 53%. The utilization rate is expected to average about the same in 1985 as additional rigs are stacked and the fleet size reduced.

With declining drilling costs offsetting the drop in oil prices the economics of drilling have improved. The cost of drilling and equipping a well in 1985 is down 35.4% from the peak in 1982. The estimated average wellhead price of crude oil in 1985 will be $24.25,

Rotary rig activity by states

	1984		Average rig activity									
	Low	Peak	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975
Alabama	11	20	15.5	15.2	15.3	17.3	10.9	12.6	12.5	13	17	14
Alaska	8	23	14.1	13.8	21.6	23.5	13.8	13.5	15.5	15	14	14
Arizona	0	1	0.2	0.3	1.0	1.1	1.0	0.0	0.4	1	1	0
Arkansas	19	36	26.1	25.9	27.0	33.9	26.8	10.4	13.9	15	15	14
California	88	134	107.2	105.7	128.8	154.8	120.2	95.6	94.1	89	89	80
Inland	67	115	89.2	83.4	106.2	133.7	104.7	85.7	86.3	81	85	77
Offshore	11	24	18.0	22.3	22.6	21.1	15.5	9.9	7.8	8	4	3
Colorado	39	65	53.9	52.2	60.3	77.8	61.1	40.2	41.1	45	38	42
Florida	1	8	3.6	4.4	4.6	7.8	4.1	5.3	6.3	6	5	9
Idaho	1	2	0.8	1.2	1.5	3.2	2.6	1.8	3.2	1	1	0
Illinois	2	61	41.5	60.2	75.5	42.9	25.4	13.1	28.4	16	22	19
Indiana	0	12	6.6	5.9	7.1	1.2	0.7	0.3	4.4	3	2	2
Kansas	79	148	127.6	124.1	157.4	196.2	120.2	66.0	75.5	67	51	57
Kentucky	3	12	8.1	8.4	9.5	5.3	1.7	0.4	3.3	2	1	1
Louisiana	269	368	309.9	283.6	343.1	455.6	427.4	347.0	338.3	292	231	227
North	24	41	30.3	29.4	39.9	58.0	54.9	34.5	39.3	35	34	31
Inland waters	43	66	51.4	47.1	59.2	83.2	76.6	62.1	62.5	57	49	55
South	75	122	96.1	81.9	107.8	160.3	156.4	112.3	113.9	81	65	64
Offshore	110	161	132.3	125.2	136.2	154.1	133.4	138.1	122.1	109	83	77
Maryland	0	1	0.0	0.0	0.0	0.6	0.2	0.5	0.7	0	1	0
Michigan	11	46	34.1	29.1	31.4	36.5	30.7	25.1	24.6	24	24	28
Mississippi	23	48	32.4	32.6	41.6	71.5	57.6	40.2	44.5	42	32	25
Montana	24	48	36.0	23.9	26.2	81.4	49.2	32.9	30.1	27	28	27
Nebraska	4	13	9.1	9.0	9.4	15.0	14.3	9.2	9.6	9	8	9
Nevada	2	8	5.0	1.1	1.0	6.9	4.6	4.1	2.9	3	2	0
New Mexico	62	102	77.8	85.0	103.3	131.9	117.6	87.5	75.5	70	54	71
New York	3	16	8.9	10.2	15.1	11.6	7.0	8.7	7.0	6	9	8
North Dakota	38	72	50.9	42.5	69.4	118.8	83.4	58.5	39.1	24	19	17
Ohio	16	80	51.1	39.3	56.8	97.8	73.7	46.3	45.6	33	26	21
Oklahoma	254	408	319.2	285.5	421.5	698.4	397.3	246.7	258.2	233	186	177
Pennsylvania	19	50	35.5	32.0	32.6	38.6	29.0	28.9	25.2	15	10	10
Rhode Island offshore	0	0	0.0	0.0	2.4	2.0	2.1	4.0	4.6	1	0	0
South Dakota	0	6	2.2	1.0	1.5	2.2	1.9	1.4	2.3	1	2	1
Texas	797	953	850.1	797.5	989.6	1,317.0	987.7	770.2	855.0	799	693	637
Gulf Coast	114	179	138.1	133.8	169.0	205.2	210.5	141.9	197.0	125	100	142
Offshore & inland waters	43	79	60.1	56.2	69.3	74.5	72.1	50.3	46.9	42	36	21
North	85	134	99.6	125.0	138.1	170.7	147.2	122.4	153.2	142	111	107
Panhandle	38	82	49.9	48.3	66.2	66.6	50.8	48.1	60.4	42	37	41
East	81	112	102.1	102.2	115.7	163.9	119.8	107.0	116.6	73	54	47
West Central	103	151	124.5	102.7	139.8	181.6	140.4	109.6	117.2	136	101	100
West	248	334	276.9	229.7	272.5	344.5	247.1	191.7	163.7	169	154	129
Utah	39	55	45.3	36.8	34.6	69.2	42.4	28.9	32.1	30	19	26
W. Virginia	25	49	37.7	33.9	49.4	[illegible]	37.8	29.8	27.1	17	12	10
Wyoming	84	140	114.6	95.6	142.7	[illegible]	155.5	147.2	136.4	[illegible]	86	107
Others	3	8	3.7	5.0	6.5	8.6	3.3	2.9	2.6	2	0	1
Total U.S.	**2,062**	**2,787**	**2,428.2**	**2,232.3**	**3,104.9**	**3,969.5**	**2,910.3**	**2,177.2**	**2,258.8**	**2,001**	**1,658**	**1,660**
Canada	76	353	245.3	109.3	195.6	250.6	306.8	334.6	270.2	217	177	133
Canada offshore	8	18	13.7	10.4	5.4	4.6	4.7	4.1	1.5	1	2	1
Grand total	**2,209**	**3,148**	**2,687.2**	**2,433.0**	**3,305.3**	**4,237.9**	**3,311.8**	**2,515.9**	**2,530.5**	**2,219**	**1,837**	**1,794**

Source: Hughes Tool Co.

down 23.7% from the peak in 1981. This improves the profit margin compared to the margin at the height of the drilling boom.

Another way of illustrating the improved economics is by comparing the volume of oil required to cover the average cost of a well. From 1970 to 1979, the number of barrels of oil that needed to be produced to cover the average cost of a well ranged from a low of 20,581 to a high of 31,394. This fell to 14,193 barrels in 1983. It is estimated that only 12,365 bbl will cover the average well cost in 1984. In 1985 the number of barrels will increase to 13,710, still well below the average of the 1970-79 era. Even though the probability of finding has decreased the amount needed to provide an economic balance has fallen sharply.

The number of barrels needed to cover the average cost of a well will increase steadily over the forecast period. It will move up to 17,668 barrels in 1990. However, this is still below any year in the 1970-1979 period. The number of producing wells in the U.S. has been increasing along with the massive number of well completions. It reached an estimated 850,444 at year end 1984.

The higher oil and gas prices have also helped lengthen the life of old wells and slowed abandonments. The number of active producing wells is expected to move up to close to 900,000 wells by year end 1985. Since operating costs have stabilized, the economics of maintaining marginal wells will be almost solely dependent upon the future price of oil.

The vast majority of U.S. operating oil wells are artificial lift wells. Over the period 1976-1984 the number of flowing wells has changed little. The number of flowing wells was 32,969 in 1976. This dropped to 31,927 in 1978 and then rebounded, moving up to 38,000 in 1981. At the end of 1984 it was estimated that there were 34,425 flowing wells. The number of artificial lift wells has increased steadily from 470,299 in 1976 to 594,960 at end 1984. This is an increase of 124,661 wells, up 26.5%. The total number of oil wells was 629,385 at year end 1984. The number of producing gas wells was 221,059, up 83,616, 60.8%, from 1976.

THE OUTLOOK — EXPLORATION & PRODUCTION

	1985	1986	1987	1988	1989	1990	Change 1985 to 1990	% change 1985 to 1990
ACTIVITY:								
Active rotary rigs	2,185	2,315	2,495	2,605	2,745	2,865	+ 680	+ 31.1
Well completions	76,325	74,625	69,895	70,285	74,125	77,455	+ 1,130	+ 1.5
Footage drilled (thousand)	320,470	315,290	305,540	305,750	329,420	345,810	+ 25,340	+ 7.9
Av. well depth	4,199	4,225	4,371	4,350	4,444	4,465	+ 266	+ 6.3
Wells rig	34.9	32.2	28.0	27.0	27.0	27.0	− 7.9	− 22.6
Footage rig	146,660	136,190	122,460	117,370	120,000	120,700	− 25,960	− 17.7
COST & REVENUE:								
Av. well cost ($)	332,465	339,445	347,085	355,765	373,550	392,230	+ 59,765	+ 18.0
Total drilling expenditures ($ million)	25,375	25,332	24,259	25,005	27,690	30,380	+ 5,005	+ 19.7
Total wellhead revenues* ($ million)	115,342	112,587	105,475	106,403	113,022	116,850	+ 1,508	+ 1.3
% of Revenues invested in drilling	22.0	22.5	23.0	23.5	24.5	26.0	—	—
PRODUCTION:								
Number of producing wells	901,770	950,395	993,290	1,035,575	1,080,700	1,128,155	+ 226,385	+ 25.1

*Net of Windfall Profit Tax

Refining/Petrochemicals

Refining and Petrochemicals

THE U.S. AND WORLDWIDE refining industry is still in a major adjustment period. This restructuring phase will continue throughout most of the forecast period.

This includes adjustment of total distillation capacity to the changing outlook for demand for petroleum products. And also adjustment of downstream conversion and upgrading capacity due to the changing product mix and changing quality of the crude to be processed.

Demand for petroleum products in the United States fell for 5 consecutive years in response to the massive price increases of the 1970's. Demand increased in 1984 after falling from 1978 and 1983.

This drop in demand is coupled with a changing perception of the trend of future demand.

There has been a substantial change in the long-range forecasts of petroleum product demand. Expectations of increases paralleling the long-range growth in economic activity of 3-4%/year have been put to rest. Long-range forecasts now call for very limited growth in demand through the year 2000. These forecasts may, in the long run, prove to be as far off the mark as the earlier optimistic outlook. But refiners now realize that the lower demand levels experienced recently are not a temporary phenomenon, and they realize that they cannot simply wait for demand to return and incur temporary profit setbacks. Operating adjustments must be made now.

United States refining capacity moved up from 13.7 million b/d in 1973 to 18.6 million b/d in 1981, an increase of 4.9 million b/d or 36.2%. During that period capacity was expanding to meet increasing actual demand and to meet expected future demand. The number of plants operating increased from 253 in 1973 to 315 in 1981. Total plants moved up from 281 to 324. The number of available plants shut down was reduced from 28 in 1973 to 9 in 1981.

The problem that refiners faced around 1980 is best understood from comparing the data on capacity with crude runs and utilization rates. The refining industry in 1980 and 1981 was still operating under the guidance of a long-term outlook that foresaw increasing demand. However, crude runs peaked in 1979 along with demand for petroleum products. But capacity continued to increase through 1981. Subsequently, the utilization rate which was as high as 90.9% in 1973 and averaged 86.6% from 1973 to 1979, dropped to 75% in 1980.

Refinery cash operating margins

Year	Gulf coast average (dollars per barrel) Margins
1975	0.47
1976	0.26
1977	0.60
1978	0.53
1979	1.47
1980	1.55
1981	0.30
1982	-1.05
1983	0.03
1984e	0.65

Source: Wright, Killen & Feldmen, Inc.

U.S. refinery capacity and utilization

	Number of plants*			Total capacity†	Crude runs	Utilization rate	Excess capacity
	Operating	Shut-down	Total	(1,000 b/d)	(1,000 b/d)	(%)	(1,000 b/d)
1973	253	28	281	13,671.4	12,431	90.9	1,240.4
1974	257	27	284	14,361.5	12,133	84.5	2,228.5
1975	262	28	290	14,960.7	12,442	83.2	2,518.7
1976	265	22	287	15,236.6	13,416	88.1	1,820.6
1977	273	18	291	16,398.4	14,605	89.1	1,793.4
1978	290	12	302	17,047.7	14,739	86.5	2,308.7
1979	301	10	311	17,440.9	14,646	84.0	2,794.9
1980	311	8	319	17,988.1	13,482	74.9	4,506.1
1981	315	9	324	18,620.5	12,471	67.0	6,149.5
1982	254	47	301	17,889.7	11,774	65.8	6,115.7
1983	233	25	258	16,859.3	11,685	69.3	5,174.3
1984	214	33	247	16,137.1	12,054	74.7	4,083.1

*As of January 1. †As of January 1. Includes operating and operable shutdown.

Source: Energy Information Administration, American Petroleum Institute

Refinery runs by districts

	Crude runs 1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
	1,000 b/d									
East Coast	1,250	1,415	1,496	1,537	1,478	1,296	1,202	1,103	960	1,018
Appalachian Dist. 1	158	170	178	180	167	158	132	93	77	87
Total Dist. 1	1,408	1,585	1,674	1,717	1,645	1,454	1,334	1,196	1,037	1,105
Appalachian Dist. 2	57	62	65	60	65	51	54	51	53	58
Ill., Ind., Ky.	2,180	2,286	2,406	2,425	2,353	2,063	1,803	1,714	1,798	1,784
Minn., Wisc., Dak.	238	257	267	279	294	238	229	251	253	282
Okla., Kan., Mo.	937	995	1,040	1,044	1,017	943	883	763	642	632
Total Dist. 2	3,412	3,600	3,778	3,808	3,729	3,295	2,969	2,779	2,746	2,756
Texas										
Inland	432	462	477	476	472	445	469	456	474	499
Gulf Coast	2,884	3,102	3,442	3,524	3,462	3,142	2,829	2,726	2,801	2,780
Louisiana Gulf	1,709	1,903	2,158	2,140	2,167	2,085	2,030	1,941	1,862	2,025
N. La., Ark.	155	169	196	214	200	186	163	162	170	177
New Mexico	80	81	87	84	89	86	81	77	75	68
Total Dist. 3	5,260	5,717	6,360	6,438	6,390	5,944	5,572	5,362	5,382	5,549
Total Dist. 4	426	442	469	488	477	442	425	416	420	436
Total Dist. 5	1,936	2,072	2,324	2,288	2,405	2,347	2,171	2,021	2,100	2,208
Total U.S.	12,442	13,416	14,605	14,739	14,646	13,482	12,471	11,774	11,685	12,054

Source: Energy Information Administration

As demand continued to fall the rate dropped to extremely unprofitable levels of utilization below 70%—67% in 1981, 65.8% in 1982 and 69.3% in 1983.

The refining industry realized that a capacity adjustment to lower demand levels was required. Capacity would have to be reduced in order to increase the utilization rate, cut unit costs, and improve margins.

From the peak in 1981 average total distillation capacity was down 13.3% in 1984 to 16.1 million b/d. This was a capacity cut of 2.5 million b/d. And the capacity as of mid year 1985 is down even lower to 15.5 million b/d.

The number of plants operating has fallen from 315 in 1981 to 214 in 1984, a drop of 101 and total plants is down from 324 to 247, off 77. There are now 33 plants shutdown.

The refining industry had historically operated in an atmosphere of ever expanding refining capacity in response to demand for products. Adjusting their planning process to accommodate a shrinking industry has been difficult. But a leaner, more efficient industry is essential if refinery margins are to improve.

Further reductions in capacity will depend upon the refiners expectations for demand for petroleum products in the future. Present demand levels increase the industry average capacity utilization rate to 78% to 80%. But refiners would prefer a rate closer to 85% to 90%. Therefore additional capacity may be shut in to boost utilization rates and decrease unit costs over the next few years. At the existing capacity if demand moves up to 17.5 million b/d in 1990, the utilization rate would average about 87%.

The problems refiners face can best be seen in looking at the value of the refined barrel compared to the cost of crude and refining costs. The total value of the refined barrel went from $14.73 in 1977, prior to the second large price hike, to $39.07 in 1981. The refiners acquisition cost of crude moved up from $11.96 in 1977 to $35.24 in 1981. Between 1977 and 1981, the net value to the refiner after subtracting refining costs was generally positive averaging about $1.05/bbl. However, rapidly rising crude oil costs coupled with rising refining costs as the utilization rate fell, turned net margins negative. Margins have fluctuated over the past 3 years, but falling product sales and high unit costs due to the low capacity utilization rate have kept margins generally negative. Refiners are going to have to be very cost conscious and possibly take some additional capacity cutting steps in order to improve margins. Although demand is improving, product prices are soft. The excess capacity situation helps maintain a very competitive atmosphere and downward pressure on product prices.

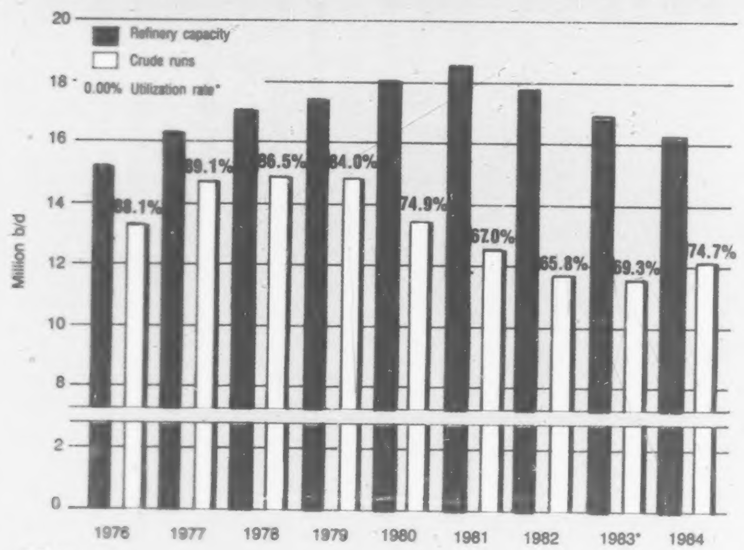
Due to lower overall capacity, increased utilization rates and improved cost control, cash operating margins turned positive during the second quarter of 1985.

In somewhat of a contradiction, capital expenditures for refining facilities will move up in 1985 and during the forecast period even though refining capacity will continue to decline.

Refining capital expenditures are expected to move up $109 million in 1985 to $3,184 million. Outlays will move up slowly through 1988, increasing to $3,290 million. Annual expenditures will increase more rapidly in 1989 and 1990 reaching $3,525 million, an increase of 10.7% from 1985.

The capital spending represents the other segment of the adjustment phase. That is investment in facilities for upgrading to be able

U.S. refining capacity and crude runs



	1976	1977	1978	1979	1980	1981	1982	1983*	1984
Refinery capacity	15.2	16.4	17.0	17.4	18.0	18.6	17.9	16.9	16.1
Crude runs	13.4	14.6	14.7	14.6	13.5	12.5	11.8	11.7	12.1

* Crude runs as percent of capacity.

Source: Energy Information Administration; American Petroleum Institute

to handle cheaper but heavier crude, and investment to be able to produce a greater yield of lighter products. As overall distillation capacity has been falling, upgrading capacity has been increasing. This trend will undoubtedly continue.

It is expected that world crude oil will continue to get heavier and with a greater sulfur content. The API weight of crude processed by United States refiners will move from about 32.6° at present to 31.8° in 1985 and 31.1° in 1990. The average sulfur content will go from about 0.96% to 1.07% in 1985 and 1.18% in 1990.

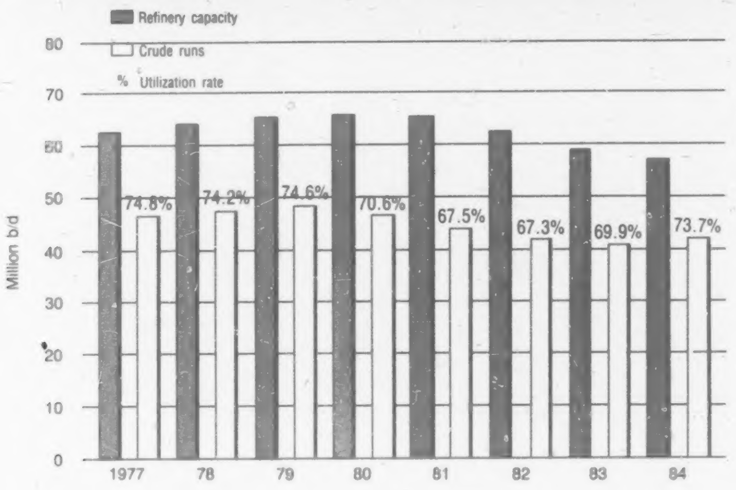
Illustrative of the shift to a greater demand for lighter products is the shift in resid and gasoline. In 1977 resid demand represented 16.7% of the demand barrel and gasoline 38.9%. By 1984 this had shifted to resid only 8.7% and gasoline 42.6%.

The ability to handle the heavier crude and upgrade the output so as to produce a greater yield of lighter products is essential for long term profitability in the refining industry.

The chemical petrochemical industry rebounded in 1983 and 1984 after slipping in 1982. Based on figures from the Chemical Manufacturers Association the value of total U.S. chemical shipments moved up 13.2% in 1984 to $214.1 billion. The value of shipments in 1983 was $189.2 billion, up 9.5% from the year earlier. Shipments had fallen 4.3% in 1982 to $172.8 billion.

The increase in the value of shipments in 1984 was due mostly to volume increases and not prices. Production volume was up almost 10% while prices were up only 2.7%. Expectations are for worldwide production to move up 4 to 5% in 1985.

Non-communist world refining capacity and crude runs



	1977	78	79	80	81	82	83	84
Refinery Capacity	62.4	64.4	65.3	66.0	65.5	62.6	59.5	57.8
Crude runs	46.7	47.8	48.7	46.6	44.2	42.1	41.6	42.6

Source: British Petroleum

Even with the increase in demand the U.S. petrochemical industry is still faced with problems of overcapacity, competition from energy rich countries, and the strong dollar overseas. These factors have had a major negative impact on margins in recent years.

As feedstock costs and other operating costs have increased, they have become a greater percentage of total costs. The margins have been reduced, and, with overcapacity worldwide, there is substantial competition. But with these reduced operating margins, price cutting is no longer an effective competition tool. Volumes cannot be increased to make up the loss of revenue. Therefore, the industry is looking for ways to cut costs.

There appears to be two basic approaches to cost cutting. One is to locate the plants closer to the feedstocks. Plants will be located in Mexico, Canada, and Saudi Arabia.

The other approach is to improve the efficiency of plants and obtain more products per unit of feedstock. Either approach will require substantial investment in petrochemical facilities. It is the latter approach that will have an immediate economic impact in the U.S. Capital spending by U.S. oil companies on petrochemical facilities is expected to increase in 1985, moving up to $1,524 million from $1,215 million in 1984. This is below the peak of $2.8 billion in 1980 and 1981.

The reason for the caution in the petrochemical industry is the uncertainty resulting from the export facilities planned in the foreign countries mentioned. However, reduced demand for crude oil may mean that competition from these facilities will be slowed. Reduced demand for crude will mean a reduction in the production of associated gas and, therefore, a reduction in feedstocks for these petrochemical facilities.

But the threat of surplus is still overhanging the market and maintaining downward pressure on prices. However, the outlook for the worldwide industry is quite positive. Demand for petrochemical output is expected to grow at about 6% per year from 1985 through 1990. For the U.S. industry the key question is, who will be in a competitive position to meet the increase in demand and sustain attractive profit margins.

THE OUTLOOK — REFINING & PETROCHEMICALS

	1985	1986	1987	1988	1989	1990	Change 1985 to 1990	% change 1985 to 1990
U.S. refining capacity (thousand barrels day)	15,525	15,300	15,200	15,100	15,100	15,200	325	2.1
Crude runs (thousand barrels day)	12,160	12,265	12,270	12,570	13,070	13,465	+ 1,305	+ 10.7
Refinery utilization rate (%)	79.6	81.5	82.0	84.6	87.9	89.9	—	—
CAPITAL SPENDING: ($ million)								
Refining	3,184	3,215	3,210	3,290	3,425	3,525	+ 341	+ 10.7
Petrochemical	1,524	1,550	1,540	1,605	1,665	1,710	+ 186	+ 12.2

Transportation

Transportation

THE LARGEST LEVEL of capital expenditures for transportation are for pipelines.

This is particularly true in today's industry. Ocean going tankers for the transportation of crude can also represent huge investments. But in today's market, with substantially reduced demand and therefore reduced import/export volumes, there is a massive surplus of tanker tonnage.

The domestic industry also uses water carriers for a substantial proportion of crude oil and product transport. But with reduced domestic demand, transport volumes have moderated in recent years. And this has reduced the need for additional investment.

Investment for other land transport and inland water transport represents smaller outlays and is less volatile. A reduction in expenditures due to lower demand has been offset by increased expenditures due to changing patterns of distribution.

Pipeline expenditures are a representation of the industry's perception of future long term needs. Most pipeline projects are of a long duration and do not have an impact on immediate needs. Therefore, the relative level of spending is a good leading indicator of the expected changes in the level of activity in the oil and gas industry.

Total expenditures on crude oil, natural gas and product pipelines in the U.S. is expected to be down 37.6% in 1985. Capital outlays are estimated at $3,221 million in 1985, a drop of $2,439 million from 1984, and an even more dramatic drop from the 1981-1983 period when outlays for pipelines were estimated at an average $7,184 million per year with the peak in 1982 at $7,390 million. The 1985 level of outlays would be down 55.2% from the average during the 1981 to 1983 boom period, or down $3,963 million.

Natural gas pipeline planned expenditures peaked at $6,070 million in 1982 and averaged $5,241 million over the 1981 through 1983 period. The expected 1985 level of $2,084 million will be down 60.2%, a drop of $3,157 million. This accounts for 80% of the decline in pipeline construction expenditures. The sharp drop in demand for natural gas and sharp cutback in drilling for natural gas had a severe impact on the construction of natural gas pipelines.

Expenditures on crude and product pipelines is expected to be down 32.7% in 1985 from the previous year, at $1,137 million. Outlays averaged $1,943 million over the 1981-1983 period with a peak of $2,456 million in 1983. The expected 1985 level will be

Total crude petroleum and petroleum products carried in domestic transportation

By mode of transportation
(Billions of Ton Miles)

Year	Total Crude And Products Ton Miles	PIPELINES Ton Miles	PIPELINES Percent Of Total	WATER CARRIERS Ton Miles	WATER CARRIERS Percent Of Total	MOTOR CARRIERS* Ton Miles	MOTOR CARRIERS* Percent Of Total	RAILROADS Ton Miles	RAILROADS Percent Of Total
1972	838.8	475.8	56.73	330.0	39.34	23.0	2.74	10.0	1.19
1973	843.6	507.0	60.10	296.8	35.16	25.0	2.96	14.8	1.76
1974	847.7	506.0	59.69	297.0	35.04	29.0	3.42	15.7	1.85
1975	846.7	507.0	59.88	298.0	35.20	27.6	3.26	14.1	1.66
1976	867.7	515.0	59.35	306.9	35.37	32.5	3.75	13.3	1.53
1977	923.4	546.0	59.13	333.3	36.09	29.6	3.21	14.5	1.57
1978	1,160.2	585.8	50.49	530.6	45.73	30.6	2.64	13.2	1.14
1979	1,174.8	608.3	51.78	522.9	44.51	30.1	2.56	13.5	1.15
1980	1,245.3	588.2	47.24	617.8	49.61	26.8	2.15	12.5	1.00
1981	1,128.4	563.7	46.27	617.2	50.66	24.9	2.04	12.6	1.03
1982	1,223.0	570.5	46.65	616.9	50.44	22.7	1.86	12.9	1.05

Total crude petroleum carried in domestic transportation

By mode of transportation
(Billions of Ton Miles)

Year	Total Crude Ton Miles	PIPELINES Ton Miles	PIPELINES Percent Of Total	WATER CARRIERS Ton Miles	WATER CARRIERS Percent Of Total	MOTOR CARRIERS* Ton Miles	MOTOR CARRIERS* Percent Of Total	RAILROADS Ton Miles	RAILROADS Percent Of Total
1972	362.0	284.5	78.6	76.0	21.0	1.0	0.3	0.5	0.1
1973	363.2	302.0	83.1	58.8	16.1	1.3	0.4	1.1	0.4
1974	358.9	303.0	84.4	53.0	14.3	1.3	0.4	1.6	0.4
1975	331.5	288.0	86.9	40.6	12.2	1.4	0.4	1.5	0.5
1976	343.8	303.0	88.1	37.8	11.0	2.1	0.6	0.9	0.3
1977	392.5	326.6	83.2	63.1	16.1	2.0	0.5	0.8	0.2
1978	623.5	359.5	57.7	261.3	41.9	2.0	0.3	0.7	0.1
1979	640.6	372.2	58.1	265.5	41.4	2.3	0.4	0.6	0.1
1980	753.0	362.6	48.2	387.4	51.4	2.5	0.3	0.5	0.1
1981	740.7	333.1	45.0	404.9	54.6	2.2	0.3	0.5	0.1
1982	774.6	339.5	43.8	432.7	55.8	2.0	0.3	0.4	0.1

Total petroleum products carried in domestic transportation

By mode of transportation
(Billions of Ton Miles)

Year	Total Petroleum Products Ton Miles	PIPELINES Ton Miles	PIPELINES Percent Of Total	WATER CARRIERS Ton Miles	WATER CARRIERS Percent Of Total	MOTOR CARRIERS* Ton Miles	MOTOR CARRIERS* Percent Of Total	RAILROADS Ton Miles	RAILROADS Percent Of Total
1972	476.8	191.3	40.1	254.0	53.3	22.0	4.6	9.5	2.0
1973	480.4	205.0	42.7	238.0	49.5	23.7	4.9	13.7	2.9
1974	488.8	203.0	41.5	244.0	49.9	27.7	5.7	14.1	2.9
1975	515.2	219.0	42.5	257.4	50.0	26.2	5.1	12.6	2.4
1976	523.9	212.0	40.5	269.1	51.4	30.4	5.8	12.4	2.3
1977	530.9	219.4	41.3	270.2	50.9	27.6	5.2	13.7	2.6
1978	536.7	226.3	42.2	269.3	50.2	28.6	5.3	12.5	2.3
1979	534.2	236.1	44.2	257.4	48.2	27.8	5.2	12.9	2.4
1980	492.3	225.6	45.8	230.4	46.8	24.3	5.0	12.0	2.4
1981	477.7	230.6	48.3	212.3	44.4	22.7	4.8	12.1	2.5
1982	448.4	231.0	51.5	184.2	41.1	20.7	4.6	12.5	2.8

*Estimate

Source: Association of Oil Pipelines

Oil/World tanker fleet, by size

(Million DWT)

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1983 Share of total	% change 83/77
10-25 000 dwt	22.6	21.9	19.7	17.5	16.1	14.8	14.2	14.1	13.8	13.5	13.0	4.6	-19.3
25-45 000 dwt	29.5	30.5	28.8	27.3	26.6	24.6	24.2	24.6	26.0	27.2	27.4	9.6	3.0
45-65 000 dwt	22.4	22.6	21.9	19.9	18.2	16.1	15.3	16.1	16.6	16.1	15.3	5.4	-15.9
65-125 000 dwt	41.6	46.4	51.2	54.4	54.2	50.8	51.2	52.5	55.4	51.8	48.4	17.1	-10.7
125-205 000 dwt	14.8	18.0	23.6	28.7	32.3	33.3	33.4	33.0	31.2	30.2	28.8	10.2	-10.8
205-285 000 dwt	78.2	105.5	125.9	138.8	142.2	142.6	142.4	139.1	131.2	118.3	104.4	36.9	-26.6
285 000 dwt and over	6.5	10.9	20.3	34.1	42.9	46.3	47.4	45.4	46.0	46.6	45.9	16.2	7.0
Total World	215.6	255.8	291.4	320.7	332.5	328.5	327.9	324.8	320.2	303.7	283.2	100.0	-14.8

Source: British Petroleum

Pipeline construction—1985 and beyond*

Area	†4-10 in.	12-20 in.	22-30 in.	Larger than 30 in.	Total
	Miles				
GAS PIPELINES					
U.S.	2,815	1,443	1,282	4,132	9,672
Canada	3,020	130	15	1,536	4,701
Latin America	1,382	1,766	1,618	368	5,134
Asia-Pacific	910	2,397	821	367	4,495
Western Europe	877	1,437	523	1,079	3,916
Middle East	188	22	94	410	714
Africa	200	233	345	1,234	2,012
Total gas	**9,392**	**7,428**	**4,698**	**9,126**	**30,644**
CRUDE PIPELINES					
U.S.	475	261	1,487	1,030	3,253
Canada	228	540	231	1,400	2,399
Latin America	99	507	51	—	657
Asia-Pacific	230	—	873	187	1,290
Western Europe	174	—	280	—	454
Middle East	522	880	2,120	122	3,644
Africa	754	591	1,102	—	2,447
Total crude	**2,482**	**2,779**	**6,144**	**2,739**	**14,144**
PRODUCT PIPELINES					
U.S.	530	1,054	540	18	2,142
Canada	211	307	28	—	546
Latin America	1,217	1,687	—	—	2,904
Asia-Pacific	482	576	—	—	1,058
Western Europe	96	130	—	—	226
Middle East	364	111	—	—	475
Africa	1,464	—	—	—	1,464
Total Product	**4,364**	**3,865**	**568**	**18**	**8,815**
NON-COMMUNIST WORLD TOTALS					
Gas	9,392	7,428	4,698	9,126	30,644
Crude	2,482	2,779	6,144	2,739	14,144
Products	4,364	3,865	568	18	8,815
Total	**16,238**	**14,072**	**11,410**	**11,883**	**53,603**

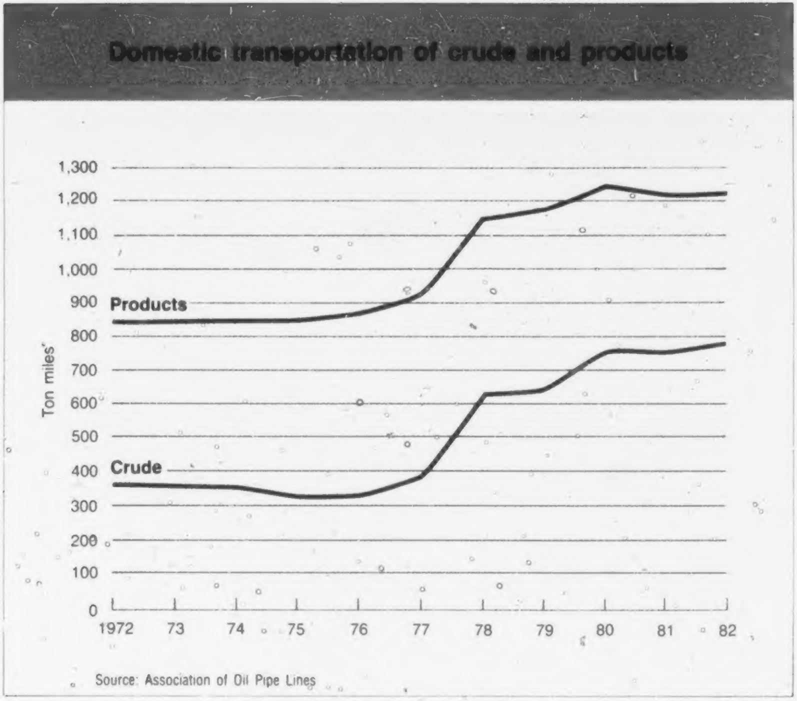
*Projects planned and under way. †Includes some projects of less than 4 in.

Source: Oil & Gas Journal

down 41.5% from the 1981-1983 average, down $806 million.

Pipeline outlays are not expected to change much from 1985 through 1988. Total expenditures are expected to increase only 3.8% to $3,275 million in 1988. However, this will begin to move up in 1989 and 1990 as demand for natural gas and petroleum products begin to increase. By 1990 expenditures will have moved up to $3,400 million, up 5.6% from 1985.

Crude and product pipeline outlays in 1990 will be at about the same level as 1985 at $1,120 million. However, as demand for natural gas moves up and exploration and production activities increase, pipeline expenditures will rise. Capital expenditures for natural gas pipelines will move up to $2,280 million in 1990, up


Domestic transportation of crude and products

Source: Association of Oil Pipe Lines

9.4%.

Total United States interstate pipeline mileage dropped in 1983 following four consecutive years of expansion from 1978 through 1982. This is a reflection of the decrease in capital spending.

There was a drop of 6,525 miles in 1983 to a total of 453,023 miles. The drop was mainly in liquids pipelines, crude oil and petroleum products pipelines. Liquids pipelines fell 4,730 miles to 167,819 miles in 1983, a drop of 2.7%.

There was a marginal drop in natural gas pipeline mileage, which fell 1,795 miles, 0.6% to 285,204 miles. In 1983 gas pipelines constituted 63% of the total.

From 1972 through 1983 total pipeline mileage has increased 32,940 miles. Liquids pipelines mileage fell 5,713 miles, a drop of 3.3%. But gas mileage moved up 38,653 miles, an increase of 15.7%. Gas pipelines accounted for all of the net addition to total mileage.

The change in total mileage does not reflect total new construction. Some old pipelines are shut down each year so that new construction represents more than net additions.

New discoveries and changing distribution patterns require an ever changing pipeline network. Pipelines are added to new or expanding producing areas and are shutdown as areas are depleted. And population growth and shifts require new distribution pipelines.

The latest survey of pipeline construction plans, by the Oil & Gas Journal, indicates an additional 4,393 miles of pipeline will be constructed in the U.S. in 1985. Natural gas pipelines will account for 65% of the addition, 2,869 miles. New product pipelines will add 1,052 miles and new crude pipelines only 472 miles.

Plans for pipeline construction for 1985 and years beyond, call for construction of an additional 15,067 miles of pipeline. Natural gas pipeline will represent 64% of the total or 9,672 miles. Crude oil pipelines account for 3,253 miles, or 22%, and products pipelines 2,142 miles, or 14%.

Although U.S. pipeline construction has fallen from the "boom" levels of 1981-1983, it is obvious that a substantial level of new construction is planned. The pipeline industry has also been required to adjust to changing expectations for the industry and changing requirements for pipeline transport. But demand for natural gas and crude oil are expected to increase during the forecast period and that will require additional pipelines.

Non-communist worldwide construction plans are now for 18,274 miles of new pipeline in 1985. Of this, 11,939 miles, 65.4%, is gas pipeline. Crude pipeline plans call for 4,008 miles, 21.9%, and products pipelines 2,327 miles, 12.7%.

For 1985 and beyond, pipeline construction plans are for an additional 53,603 miles. Natural gas pipelines would amount to 30,644 miles, 57.2%, crude oil pipelines 14,144 miles, 26.4% and products pipelines 8,815 miles, 16.4%.

Pipeline construction represents large expenditures, and costs are basically dependent upon the diameter of the pipe and the terrain of the construction site. The latest estimates of construction costs from the Oil & Gas Journal pipeline economics report are:

Onshore pipelines:	
4-10 inch	$ 381,617/mile
12-20 inch	$ 397,025/mile
22-30 inch	$ 849,817/mile
over 30 inch	$1,303,040/mile
Offshore pipelines:	
10 inch	$1,048,242/mile
12-20 inch	$ 914,810/mile
24 inch	$1,415,010/mile

In addition to the cost of the pipeline is the cost of the compressor stations and pumping stations required to move natural gas and liquids. The latest survey shows compression costs at $1,531/horsepower, and 110 horsepower of compression per mile. This translates into additional costs of $168,400/mile.

Pipeline construction costs continue to escalate, reflecting work in more remote areas onshore and offshore.

U.S. capital expenditures for other transport in the industry is expected to reflect the movements in demand and prices over the 1985-1990 forecast period. Spending is expected to fall off from $421 million in 1985 to $400 million in 1987. It will move up to around $440 million in 1990 as the industry rebounds with increasing demand.

The worldwide tanker industry has been severely depressed in recent years as crude and products trade dropped sharply from the peak of 1978-1979. The tanker fleet fell from the peak of 326.2 million deadweight tons in 1977 to an estimated 268 million deadweight tons in 1984. This was a drop of 17.8%. Much of the existing tonnage is idle or under-utilized.

The adjustment has taken the shape of eliminating redundant VLCC tankers. They are used mainly for long distance transport, and the long haul volumes of crude from the Persian Gulf to the United States have been cut sharply. The industry is now concentrating on smaller and more flexible tankers. To hold down losses, many excess tankers have been converted for other uses, such as offshore storage.

The development of the North Sea oil fields has also had substantial impact on the tanker industry. As these fields developed, Europe was transformed from long haul tanker trade to short haul. In the early and mid 1970's Europe relied primarily on long haul oil from the Persian Gulf. This oil moved in VLCC tankers through the Straits of Hormuz and around the Cape of Good Hope.

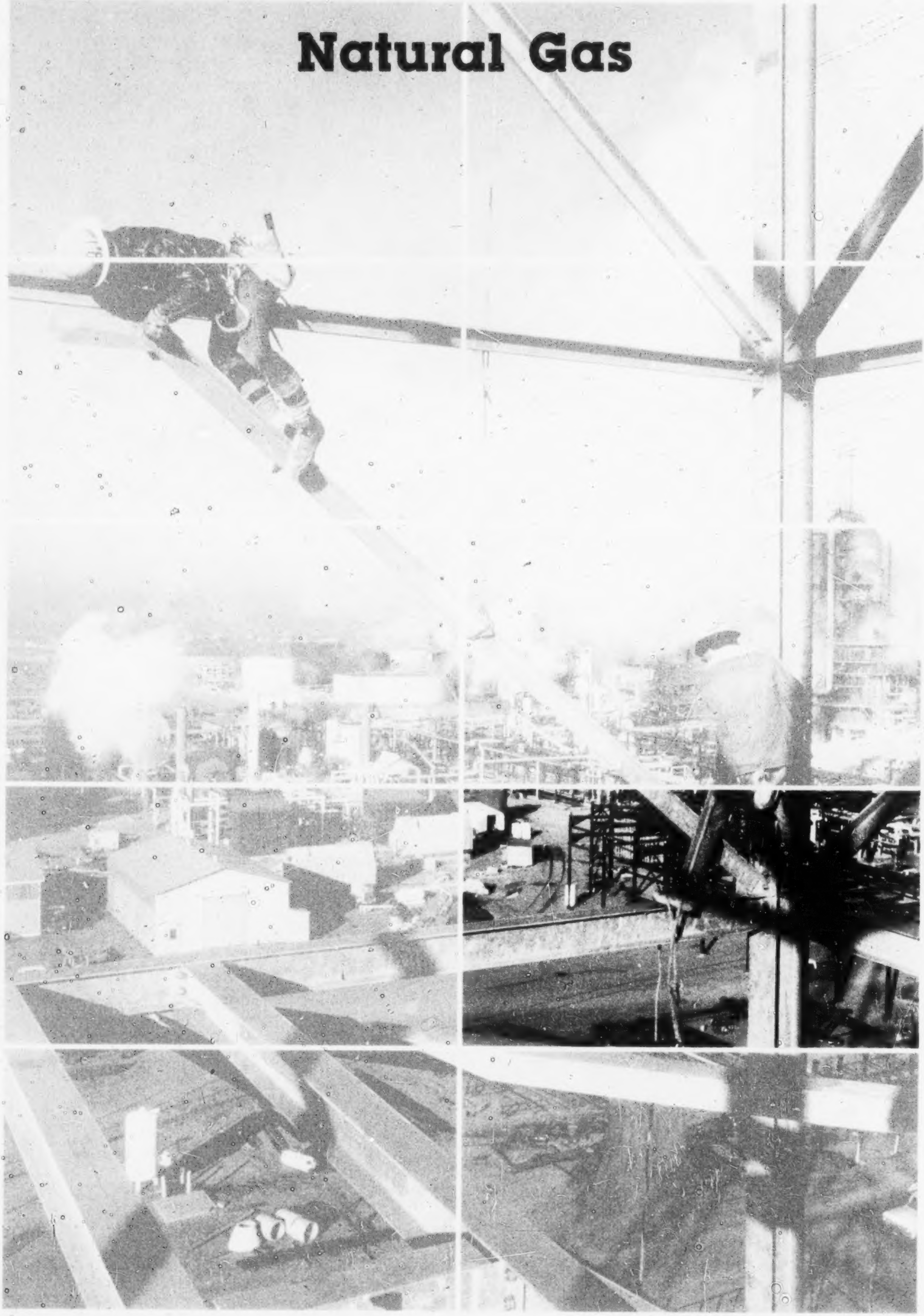
U.S. import requirements appeared to be the real key to improvement in tanker needs. And this is dependent upon some increase in demand for crude oil. Profitability in the tanker industry will also depend on scrappage rates which would reduce the overall size of the fleet and increase average utilization rates. Still there is substantial excess capacity to be absorbed. There should be substantial improvement toward the end of the forecast period when U.S. import requirements move up rapidly.

Capital expenditures on other land and inland water transport in the U.S. will be primarily for replacement. Changing distribution patterns will have an impact. There will be a substantial increase in shipments of crude oil from California's outer Continental Shelf which should boost demand for U.S. tankers late in the forecast period.

THE OUTLOOK — TRANSPORTATION

	1985	1986	1987	1988	1989	1990	Change 1985 to 1990	% change 1985 to 1990
CAPITAL SPENDING ($ million)								
Gas pipelines	2,084	2,170	2,110	2,225	2,205	2,280	+196	+9.4
Crude and product pipelines	1,137	1,070	1,090	1,050	1,140	1,120	− 17	−1.5
Other transport	421	420	400	425	435	440	+19	+4.5

Natural Gas



Natural Gas

MARKET FORCES cannot be ignored indefinitely. And this rule of economic activity has proven to also be true in a highly regulated industry. As other energy costs moved up natural gas prices began to rise slowly in the early 1970's and then skyrocketed between 1973 and 1982. This rapid rise in prices had the expected effect and demand fell.

Natural gas prices continued to move up while prices of competing fuels were falling, during the 1981 to 1984 period. It became evident that natural gas was a part of the larger energy industry, and that at a high enough price level gas ran into competition from other fuels. Natural gas lost market share due to the change in relative prices. And sluggish economic activity help cut natural gas demand even further.

Prices leveled in 1984 and economic activity moved up resulting in a rebound in demand for natural gas. Prices are expected to remain relatively constant in 1985 and the economy is continuing its growth. As a result, natural gas demand is expected to move up again in 1985.

The economics of the natural gas industry have been distorted by the continuous government interference with the market mechanism via a vast array of controls and regulations.

The major reason for the present problem in the natural gas industry was the Natural Gas Policy Act (NGPA) enacted in 1978. This act gave the Federal Power Commission the power to determine natural gas price rates charged by interstate natural gas pipeline companies to gas utilities. Under NGPA almost all gas production rather than only gas produced for the interstate market was put under controls.

A complicated schedule of prices was established for gas, categorized by when it was initially developed and other classifications. One of the major problems with the NGPA, and any attempt at government price controls, is that there is no sufficient self-correcting mechanism that allows for movement to equilibrium at a market clearing price.

The NGPA was founded on the assumption that government regulators/central planners could actually precisely forecast the demand and supply of natural gas and, therefore, the market clearing price. Controls coupled with problems arising from long term contractual rigidities created a serious economic distortion in the

United States natural gas supply and demand

	Billion cu ft					
	1975	1980	1981	1982	1983	1984
Marketed production	20,109	20,180	19,956	18,520	16,822	18,063
Supplemental gas	0	155	176	145	132	137
Imports	953	985	904	933	920	861
Losses (including extraction)	(1,107)	(1,417)	(1,276)	(1,237)	(1,432)	(1,310)
Total Supply	**19,955**	**19,903**	**19,760**	**18,361**	**16,442**	**17,751**
Exports	73	49	59	52	55	55
Stock change	344	(23)	297	308	(448)	211
Domestic demand	**19,538**	**19,877**	**19,404**	**18,001**	**16,835**	**17,485**
	Sector Demand (Trillion BTU)					
Residual & commercial	7,581	7,539	7,243	7,434	7,025	6,914
Industrial	8,532	8,394	8,258	7,117	6,823	7,384
Transportation	595	648	657	613	505	524
Electric utility	3,240	3,810	3,768	3,343	2,999	3,205
Total	**19,948**	**20,391**	**19,926**	**18,507**	**17,352**	**18,027**

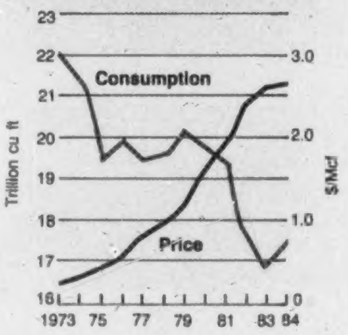
Source: Energy Information Administration

Natural gas processing and liquids production

	Billion cu ft			Natural gas liquids	
	Gross gas production	Gas processed	Percent processed	Gallons per Mcf of gas processed	Liquids produced (000 b/d)
1970	23,786	18,509	77.8	1.376	1,661
1971	24,088	19,252	79.9	1.348	1,693
1972	24,016	19,906	82.9	1.347	1,744
1973	24,067	19,679	81.8	1.353	1,737
1974	22,849	18,684	81.8	1.386	1,689
1975	21,103	17,748	84.1	1.410	1,632
1976	20,944	17,718	84.6	1.388	1,604
1977	21,097	17,570	83.2	1.400	1,618
1978	21,308	17,012	79.8	1.381	1,567
1979	21,883	16,400	75.0	1.481	1,585
1980	21,870	15,750	72.0	1.537	1,576
1981	21,587	15,700	72.7	1.572	1,610
1982	21,210	14,800	73.3	1.605	1,550
1983	18,381	13,470	73.3	1.781	1,565
1984	19,900	14,340	72.0	1.707	1,592

Source: IPAA

Natural gas consumption and price



Source: Energy Information Administration

U.S. gas production and reserves

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	% change 84/72
	(Billion cu ft)													
Marketed production:														
Texas	8,658	8,514	8,171	7,486	7,192	7,051	6,548	7,175	7,116	6,910	6,469	5,939	6,130	−29.2
Louisiana	7,973	8,242	7,754	7,090	7,007	7,215	7,476	7,266	6,940	6,780	6,172	5,332	5,824	−26.9
Others	5,901	5,892	5,676	5,533	5,753	5,759	5,950	6,030	6,124	6,266	5,879	5,551	6,110	3.5
Total U.S.	**22,532**	**22,648**	**21,601**	**20,109**	**19,952**	**20,025**	**19,974**	**20,471**	**20,180**	**19,956**	**18,520**	**16,822**	**18,064**	**−19.8**
	(Billion cu ft)													
Reserves*														
Total U.S.	266,085	249,950	237,132	228,200	216,026	208,878	200,302	200,997	199,021	201,730	201,512	198,000	198,000	−25.6
	(Years)													
Reserves/production ratio:														
Total U.S.	11.81	11.04	10.98	11.35	10.83	10.43	10.03	9.82	9.86	10.11	10.88	11.77	10.96	

*1983 & 1984 author's estimates

Source: American Petroleum Institute; Energy Information Administration industry.

Over the 10 year period 1973-1982 the average wellhead price of natural gas went up 1118.2% from $0.22/mcf in 1973 to $2.46/mcf in 1982. That is an average annual increase of 30.8%. Faced with that rate of increase in natural gas energy costs, an effort was made by all consumers to conserve.

Price increases were somewhat more moderate during 1983 and 1984. The average wellhead price moved up 5.3% in 1983 to $2.59/mcf and up a modest 1.5% in 1984 to $2.63/mcf. From 1973 through 1984 the price increase was $2.41/mcf.

Over the same period the price paid by electric plants increased $3.36/mcf from $0.35/mcf in 1973 to $3.71/mcf in 1984. The residential price moved up $4.77/mcf from $1.29/mcf in 1973 to $6.06/mcf in 1984.

The price paid by electric utilities moved up 960% and the residential price moved up 369.8% over the 1973-1984 period. This led to a great deal of conservation and fuel switching.

Consumption of natural gas fell from 22.05 trillion cu ft in 1973 to 16.84 trillion cu ft in 1983, a drop of 23.6%. It rebounded to 17.49 trillion cu ft in 1984, an increase of 3.9% from the previous year. But compared to 1973 demand is still down 20.7%.

Even in the face of falling demand throughout 1981 and 1982, prices continued to move up relentlessly. Long term contracts entered into, when the accepted outlook was for a natural gas storage, continued to push up prices.

Because of the take or pay provisions in most contracts, it became advantageous for the pipelines purchasing gas to continue to take high priced gas and curtail acceptance of the lower priced gas when demand began to fall. This aggravated the situation and drove up the cost. This cost was passed on to consumers.

Natural gas has always held a cost advantage over heating oil in the residential market and a cost advantage over residual fuel oil in the utility and industrial sectors. By 1982 a substantial portion of this cost advantage had eroded and natural gas was meeting competition it had not experienced before. In the residential sector, conversions from home heating oil to natural gas slowed. And in the industrial and utilities sectors, natural gas fell victim to the recession and to competition from other fuels. This was also due to the fuel use regulations which gave industry and utilities low priority in the case of a curtailment of supply. Without assurances of a reliable source of gas, industry has sought other fuels.

In fact, industry has been moving towards installing multiple fuel capabilities so they can take advantage of any price differentials between fuels. This also may become prevalent for residential and commercial heating in future years. The overall result of the natural gas market distortions has been the present gas surplus with deliverability far in excess of demand. A great deal of concern was expressed over a possible "fly-up" in prices when partial decontrol occurred as of the 1st of 1985. But again the influence of market forces was far stronger than presumed by regulators. With substantial competitive pressure from other fuels natural gas prices during the first part of 1985 were actually lower than the previous year. It is not expected that there will be any significant increase in prices in 1985. The average wellhead price is forecast to move up a marginal 3¢/mcf in 1985 to $2.66/mcf. This is an increase of 1.1% and is due primarily to the repricing of some decontrolled gas at a higher price.

There is actually a distinct possibility that prices may come down.

Marketed production of natural gas by states

State	1978	1979	1980	1981	1982	1983	1984
				(Billion cu ft)			
Alabama	85.6	85.8	65.3	79.2	75.0	90.8	87.1
Alaska	203.1	220.8	230.6	242.6	264.4	276.7	279.7
Arkansas	106.8	109.5	111.8	93.0	124.6	127.6	163.9
California	311.1	248.2	309.4	380.4	384.0	415.3	465.9
Colorado	183.7	191.2	188.0	195.7	209.9	163.5	180.0
Florida	51.6	50.2	40.6	32.5	22.5	21.1	13.0
Kansas	854.5	797.8	735.0	640.1	429.6	434.7	466.2
Louisiana	7,476.5	7,266.2	6,939.9	6,780.2	6,171.6	5,332.1	5,823.7
Michigan	148.0	159.7	158.3	152.6	153.1	138.9	136.3
Mississippi	106.6	144.1	175.1	181.2	167.2	151.2	158.1
Montana	46.5	53.9	51.9	56.6	56.6	52.0	52.0
New Mexico	1,174.2	1,181.4	1,148.1	1,132.1	991.2	895.3	951.6
North Dakota	30.5	18.5	42.3	42.6	53.8	69.3	77.3
Oklahoma	1,773.6	1,835.4	1,891.8	2,019.2	1,934.4	1,730.1	2,079.7
Texas	6,548.2	7,174.6	7,115.9	6,910.0	6,468.8	5,938.5	6,130.2
Utah	58.4	58.6	87.8	91.2	94.3	63.1	52.3
W. Virginia	148.6	150.5	156.6	161.3	150.9	130.1	138.1
Wyoming	357.3	414.4	407.1	408.3	424.7	444.0	498.9
Others	309.2	310.5	324.2	357.0	343.2	347.8	310.1
Total	19,974.0	20,471.3	20,179.7	19,955.8	18,519.7	16,822.1	18,064.1
Volume change	51	497	292	224	1,436	1,698	1,242
Percent change	0.3	2.5	1.4	1.1	7.2	9.2	7.4

*Includes nonhydrocarbon gases

Source: Energy Information Administration

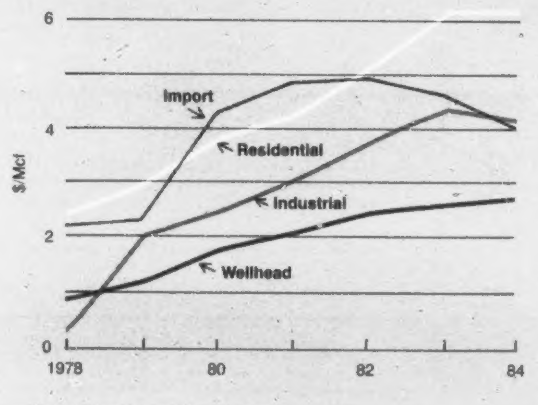
Production, imports

	Total marketed prod	Imports	Total new supply*	Imports % total supply
		(Billion cu ft)		
1973	22,648	1,033	23,681	4.4
1974	21,601	959	22,560	4.3
1975	20,109	953	21,062	4.5
1976	19,952	964	20,916	4.6
1977	20,025	1,011	21,036	4.8
1978	19,974	966	20,940	4.6
1979	20,471	1,253	21,724	5.8
1980	20,180	985	21,320	4.6
1981	19,956	904	21,036	4.3
1982	18,520	933	19,598	4.8
1983	16,822	920	17,874	5.1
1984	18,063	861	19,061	4.5

*Before losses

Source: Energy Information Administration

Natural gas prices



Source: Energy Information Administration

	1978	1979	1980	1981	1982	1983	1984
				$/1,000 cu ft			
Wellhead price	0.91	1.18	1.59	1.98	2.46	2.59	2.63
Import price	2.21	2.60	4.42	4.84	4.94	4.51	4.08
Industrial sales price	1.54	2.01	2.53	3.11	3.73	4.26	4.13
Residential price	2.56	2.98	3.68	4.29	5.17	6.06	6.06

Source: Energy Information Administration

With crude oil prices sliding and therefore the cost of competing fuels coming down, there will be a lot of downward pressure on natural gas prices.

Prices are not expected to increase during the first three years of the forecast period and the average wellhead price still will be around $2.66/mcf in 1988. Economic growth will spur demand toward the end of the forecast period, 1989-1990, and prices are forecast to move up. The price will increase 6.4% in 1989 and an additional 4.6% in 1990. The average wellhead price will be $2.96/mcf in 1990, up 11.3% from 1985. This is an average annual increase of only 2.2% over the forecast period.

The natural gas industry is having to adjust to the changing conditions. The market competition is forcing a transition to a net back form of pricing. No longer will prices be built up from the wellhead to the consumer by adding up the incremental costs of production, transmission, and distribution, with the burner tip price a regulated price covering all of these costs. The market will determine burner tip price, and well-head price will be burner tip price less transmission, distribution cost.

With lower prices and continued economic growth demand for natural gas is expected to move up 2.7% in 1985 to 17.95 trillion cu ft.

The leveling of prices coupled with continued economic growth and more aggressive marketing of gas should boost demand/consumption throughout most of the 1985-1990 period. Demand is expected to move up 5.7% by 1990 to 18.98 trillion cu ft. This will be up 2.1 trillion cu ft from the low in 1983.

Marketed production of natural gas in the U.S. followed demand falling from 22,648 billion cu ft in 1973 to 16,822 billion cu ft in 1983, down 25.7%. Production moved up in 1984 to 18,064 billion cu ft, an increase of 7.4%.

There has been some concern expressed about the impact of natural gas imports on demand for domestic production. However, there does not appear to be any upward trend in gas imports. From 1973 through 1983 imports ranged from 904 billion cu ft to 1253 billion cu ft. As a percentage of total supply they ranged from 4.1% in 1974 and 1981 to 5.5% in 1979. The average was 4.5% of total supply. Imports fell to 861 billion cubic feet in 1984, 4.3% of domestic supply.

Import prices in recent years have been higher than domestic prices and therefore there was no great incentive to increase import volumes. However, Canada has recently adjusted prices to be more competitive in the U.S. market and is taking steps to promote increased exports to the U.S.

Imports are expected to increase over the forecast period at a faster rate than domestic production. Domestic U.S. marketed production is expected to increase 965 billion cu ft in 1990. Over the same period imports are expected to move up 290 billion cu ft, 30.2%, to 1250 billion cu ft.

Increased domestic production is dependent upon an adequate level of exploration and development activity over the forecast period. Lower prices and diminished demand have been coupled with the threat of higher taxes to reduce exploration activity. U.S. estimated proved reserves have fallen from 290,746 billion cu ft in 1971 to 198,000 billion cu ft at year end 1984. This is a drop of 31.9%. Some concern is being expressed about the long range availability of adequate supplies. If action is taken to stimulate exploration there may be a bright future ahead for producers of natural gas.

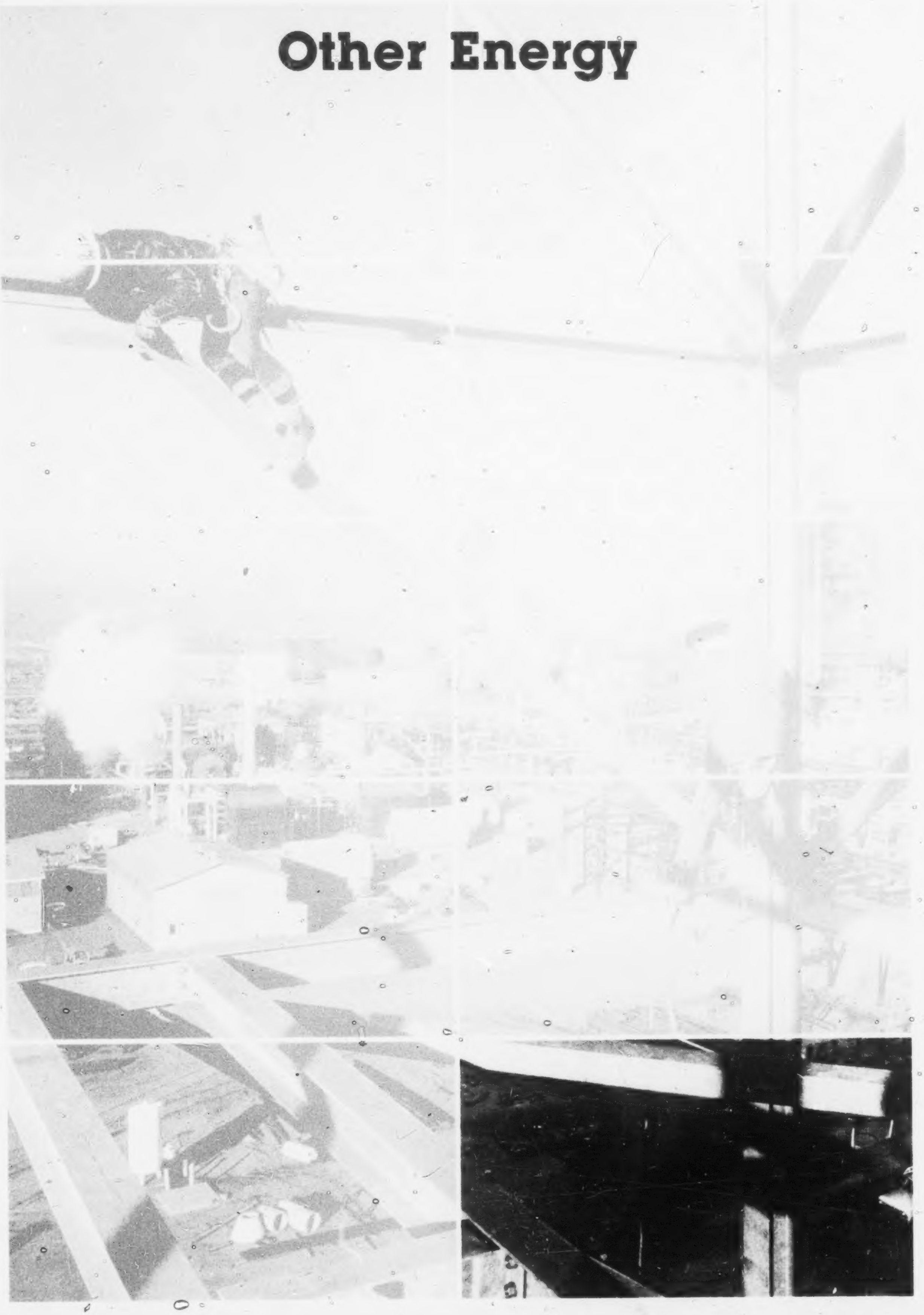
Marketed gas production in 1984 was 20.2% below 1973. However, natural gas liquids (NGL) production fell only 6% over the same period. NGL output was 1,738,000 b/d in 1973 and dropped to 1,633,000 b/d in 1984.

NGL production has not fallen as sharply as gas production because of deeper extraction of NGL, and increased plant efficiencies. Natural gas liquids recovered per unit of gas processed has increased from 28 bbl per million cu ft of gas in 1973 to 33 bbl in 1984. This is an increase of 17.9% in liquid extraction levels. The level of extraction is closely tied to the relative value of the liquids and the value of natural gas.

THE OUTLOOK — NATURAL GAS

	1985	1986	1987	1988	1989	1990	Change 1985 to 1990	% change 1985 to 1990
NATURAL GAS: (billion cubic feet)								
Marketed production	18,110	18,325	18,350	18,575	19,030	19,075	+ 965	+ 5.3
Imports	960	1,060	1,000	1,050	1,150	1,250	+ 290	+ 30.2
Demand	17,950	18,255	18,250	18,340	18,880	18,980	+ 1,030	+ 5.7
SECTOR DEMAND:								
Residential	4,355	4,385	4,375	4,375	4,425	4,430	+ 75	+ 1.7
Commercial	2,390	2,410	2,400	2,400	2,435	2,440	+ 50	+ 2.1
Industrial	6,315	6,440	6,425	6,455	6,720	6,750	+ 435	+ 6.9
Electric utilities	3,240	3,340	3,370	3,420	3,560	3,610	+ 370	+ 11.4
Pipeline & plant fuel	1,650	1,680	1,680	1,690	1,740	1,750	+ 100	+ 6.1
Total demand	**17,950**	**18,255**	**18,250**	**18,340**	**18,880**	**18,980**	**+ 1,030**	**+ 5.7**
WELLHEAD PRICE ($ per thousand cubic ft)	2.66	2.67	2.60	2.66	2.83	2.96	+ 0.30	+ 11.3

Other Energy



Other Energy

IN TERMS of the total energy required to fuel economic activity, petroleum and natural gas are only a part of the total need.

Petroleum, in fact, is to a major extent the "swing" fuel, providing energy needs not met by other fuels. This is particularly true with respect to energy for electrical generation and for heavy industry. Those sectors of the economy look to petroleum only when there is insufficient energy available from cheaper fuel sources such as coal, hydroelectric and nuclear. This has been particularly true since the 1970s after the price of petroleum skyrocketed.

Recently, as the cost of oil has fallen and the cost of other fuels has continued to increase, the competitive picture has changed. Both petroleum products and natural gas are becoming more price competitive. This has boosted demand for petroleum products and natural gas. And it has also slowed the conservation effort that promoted investment in conversion to other cheaper fuels.

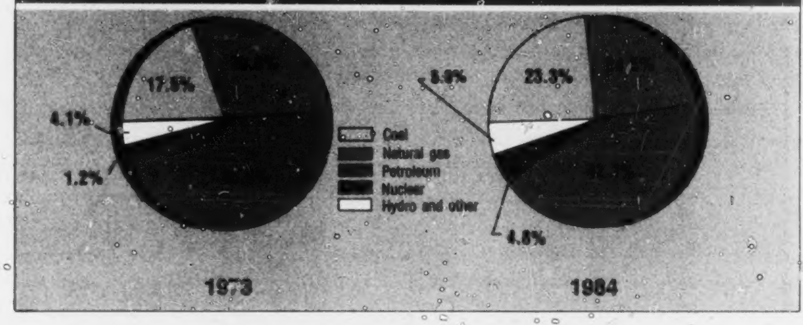
Lower cost petroleum and natural gas considerably changes the financial economics of investing in capital equipment to convert to other fuels. It lengthens the pay back period on the increased capital investment. In many cases conversion has become uneconomical.

Petroleum does have its secure niche as a liquid fuel for transportation, a role that does not appear to be threatened. In fact, most long range forecasts do not see any major economic alternative for petroleum as a transport fuel. But even in this section some alternatives have been introduced. Automobiles and small trucks have been converted to use propane. And there is continuous experimentation with electric cars for short range city transport.

One of the most consistent and long lasting trends has been the growth in the consumption of electrical energy. In 1984, 35.4% of the total energy consumed was energy input for the electric utility industry. The percentage of energy for electrical generation has steadily been increasing, moving up from 26.6% in 1973. This upward trend, to a higher percentage of energy for electrical generation, will continue for the forseeable future. The economy is shifting to more service and information oriented activity, industry is shifting toward more automation, and both of these movements call for energy in the form of electricity.

Providing adequate electrical power to meet this growing demand may become a serious issue in the 1990's. The two major sources of

Consumption of energy by source



Electricity generation and fuel consumption

	Total electricity generated (Billion kwh)	Fuels consumed: Coal (1,000 st)	% of total	Petroleum (1,000 bbl)	% of total	Natural gas (bcf)	% of total	Nuclear, hydro & other % of total
1973	1,860.7	389,212	45.6	560,248	16.9	3660.2	18.3	19.2
1974	1,867.1	391,811	44.4	536,274	16.1	3443.4	17.1	22.4
1975	1,917.6	405,962	44.5	506,128	15.1	3157.7	15.6	24.8
1976	2,037.7	448,371	46.4	555,920	15.7	3080.9	14.4	23.5
1977	2,124.3	477,126	46.4	623,705	16.9	3191.2	14.4	22.3
1978	2,206.3	481,235	44.2	635,839	16.6	3188.4	13.8	25.4
1979	2,247.4	527,051	47.8	523,297	13.5	3490.5	14.7	24.0
1980	2,286.4	569,274	50.8	420,214	10.8	3681.6	15.1	23.3
1981	2,294.8	596,797	52.4	351,111	9.0	3640.2	15.1	23.5
1982	2,241.2	593,666	53.2	249,771	6.6	3225.5	13.6	26.6
1983	2,310.3	625,211	54.5	245,497	6.3	2910.9	11.9	27.3
1984	2,416.3	664,399	55.5	204,479	5.0	3112.3	12.3	27.2

Source: Department of Energy

Electric sector: relation to total product demand

	Total coal consumption (1,000 short tons)	Coal consumed in electric generation (1,000 short tons)	%	Total petroleum consumption (1,000 b/d)	Petroleum consumed in electric generation (1,000 b/d)	%	Total natural gas consumption (bcf)	Natural gas consumed in electric generation (bcf)	%
1973	562,584	389,212	69.2	17,308	1,535	8.9	22,049	3660.2	16.6
1979	680,524	527,051	77.5	18,513	1,433	7.7	20,241	3490.5	17.2
1984	791,296	664,399	84.0	15,707	560	3.6	17,485	3,112.3	17.8

Source: Department of Energy

Coal production

	Production	Consumption	Imports	Exports
	1,000 short tons			
1973	598,568	562,584	127	53,587
1974	610,023	558,402	2,080	60,661
1975	654,641	562,641	940	66,309
1976	684,913	603,790	1,203	60,021
1977	697,205	625,291	1,647	54,312
1978	670,164	625,225	2,953	40,714
1979	781,134	680,524	2,059	66,042
1980	829,700	702,729	1,194	91,742
1981	823,775	732,627	1,043	112,541
1982	838,112	706,911	742	106,277
1983	782,091	736,672	1,271	77,772
1984	890,043	791,296	1,286	81,483
% chg 84/73	+48.7	+40.7	+912.6	+52.1

Source: Energy Information Administration

energy for electric power generation are coal and nuclear power. Both of these sources are under attack from groups concerned about nuclear power dangers and potential pollution.

Coal has been, and continues to be, the primary fuel source for electric utilities. Coal has moved up from 43.6% of the fuel used in 1973 to 54.0% in 1984. Over the same period, nuclear fuel increased its share from 4.6% to 13.7%

Moving down, petroleum went from 17.7% of the fuel consumed for electrical power generation in 1973, to 4.9% in 1984. The amount of petroleum consumed for electrical power generation fell 63.6%.

The natural gas share of energy consumed for electrical generation fell from 18.9% in 1973 to 12.3% in 1984. The amount of gas consumed for power generation fell 15.0% over the same period.

Hydroelectric, geothermal and other power accounted for 15.2% of the total energy in 1973 and was 15.1% in 1984.

The share of total petroleum demand consumed by electric utilities has fallen from 8.9% in 1973 to 3.6% in 1984. The amount consumed for electrical output dropped from 1.535 million b/d in 1973 to 558,685 b/d in 1984, a decline of 63.6%.

The amount of natural gas consumed by electric utilities increased 6.9% in 1984, but this followed a 9.8% drop in 1983. Consumption in 1984 was 3,112 billion cubic feet, 17.8% of total consumption of 17,485 billion cubic feet. In 1973 electric utilities consumed 3,660 billion cubic feet of gas, 16.6% of the total gas consumed.

Natural gas consumed by the electric utility sector in 1984 was down 15% from the 1973 level.

As prices leveled natural gas improved its competitive position. The demand by electric utilities may move up again in 1985. However, any increase will be relatively small. Future increases in natural gas consumption by the electric utilities will depend upon the increase in nuclear output and the pollution problems perceived to be associated with increased coal consumption.

Because of cost advantages, coal and nuclear power will continue to displace petroleum and natural gas whenever possible. Hydropower will continue to provide energy to the full extent available but is dependent upon existing weather conditions.

Nuclear will continue to increase but its long-range growth is becoming dependent upon political conditions rather than economic ones.

With its cost advantage, coal consumption by electric utilities should continue to increase. The long term outlook, however, may be clouded by environmental considerations, particularly the acid rain issue.

If the problems associated with nuclear power and coal consumption restrict their expansion, demand for natural gas and petroleum for electrical power output could well increase.

Total coal consumption has risen steadily since 1973. Coal demand was 562.6 million short tons in 1973 and increased to 791.3 million short tons in 1984, up 40.7%. Coal consumption varies with economic activity but increased consumption by electric utilities continues to push up demand over time. Coal consumed by electric utilities has increased 70.7% from 389.2 million short tons in 1973 to 664.4 million short tons in 1984. The percentage of total coal consumed in electric generation increased from 69.2% in 1973 to 84.0% in 1984. Over this period coal consumed by utilities moved up 275 million short tons. Total coal consumption moved up only

Nuclear power plant operations

	Number of reactors	Electricity generated (million net kwh)	% of total electricity generated	Maximim dependable capacity (million net kw)	Capacity utilized
1973	39	83,479	4 5	22 900	52 9
1974	48	113,976	6 1	31 710	48 3
1975	54	172,505	9 0	33 312	59 7
1976	60	191,104	9 4	43 277	57 8
1977	65	250,883	11 8	46 046	64 1
1978	70	276,403	12 5	46 629	65 7
1979	68	255,155	11 4	49 326	58 7
1980	70	251,116	11 0	51 059	57 1
1981	74	272,674	11 9	55 534	58 4
1982	77	282,773	12 6	59 552	57 2
1983	80	293,677	12 7	62 809	54 8
1984	86	325,177	13 5	69 522	56 0
% chg 84 73	+ 120 5	+ 289 5	—	+ 203 6	—

Source: Energy Information Administration

Electricity sales

	Residental	Commercial	Industrial (Million kwh)	Other	Total
1973	579,231	388,266	686,085	59,328	1,712,910
1974	578,184	384,826	684,875	68,039	1,705,924
1975	588,140	403,049	687,680	68,222	1,747,091
1976	606,452	425,094	754,069	69,631	1,855,246
1977	645,239	446,514	786,037	70,571	1,948,361
1978	674,466	461,163	809,078	73,215	2,017,922
1979	682,819	473,307	841,903	73,070	2,071,099
1980	717,495	488,156	815,067	73,732	2,094,449
1981	722,265	514,338	825,742	84,756	2,147,101
1982	729,519	526,397	744,949	85,575	2,086,440
1983	750,948	543,788	775,999	80,219	2,150,955
1984	779,774	578,654	841,800	82,084	2,282,311
% chg 84 73	+ 34 6	+ 49 0	+ 22 7	+ 38 4	+ 33 2

Source: Energy Information Administration

228.7 million short tons. Obviously the long run growth in coal consumption is dependent upon the growth in electrical generation. Since there is a trend to increased demand for electrical power, demand for coal should continue to move up through 1990.

Total coal consumption in 1985 is estimated to move up 3.3% to 817 million short tons. Electric utility coal consumption will move up to an estimated 687 million short tons.

From 1985 - 1990, as the economy continues to expand, electric power demand will move up. Coal consumption will follow upward as the primary source of energy for electrical generation.

Total coal consumption will move up approximately 16% to 948 million short tons. Electric utility consumption will move up about 18% to 810 million short tons.

Although coal will continue to be the primary fuel for electric power generation the contribution of nuclear power will increase substantially. The number of operable nuclear reactors increased from 39 at year end 1973 to 86 at year end 1984. Electricity generated increased from 83.5 million kilowatthours in 1973 to 327.6 million kilowatthours in 1984, a 292.5% increase.

The maximum dependable capacity moved up from 22.900 million net kilowatts in 1973 to 69.522 million net kilowatts in 1984, up 203.6%. The percentage of capacity utilized has fluctuated substantially. It has varied from 48.3% in 1974 to 65.7% in 1978. After the Three Mile Island incident the utilization rate fell. Concerns for safety increased the down time for maintenance and safety checks.

The rate fell to 54.8% in 1983. But the rate improved in 1984, moving up to 56.5%. Both capacity and the utilization rate are expected to move up in 1985 and throughout the forecast period. Additional operable reactors have already come on stream bringing the present total to 88. Nuclear based electricity generation is expected to increase to approximately 345.5 billion kilowatthours in 1985. This will move up to 445 billion kilowatthours by 1990.

Because of the political debate over the safety of nuclear power, the long term growth of nuclear power is uncertain. However, increased capacity from newly commissioned plants and increased output from existing plants should boost nuclear energy output over the 1985 to 1990 period. New facilities will be commissioned cautiously and will slow the rate of growth. With lead times of 10 years on construction of new reactors, it does not appear that substantial long range growth can be expected.

As the economy grows through the forecast period 1985 to 1990, additional energy will obviously be required. The shift toward a more service oriented and automated economy will increase demand for electrical power. And electric power consumption will increase faster than demand for energy. Coal and nuclear energy will continue to increase their market shares of fuel for electric power generation and therefore their share of total energy. This shift will accelerate as the economy expands more rapidly at the end of the 1980's.

THE OUTLOOK — OTHER ENERGY

	1985	1986	1987	1988	1989	1990	Change 1985 to 1990	% change 1985 to 1990
ENERGY DEMAND (trillion BTU)								
Coal	17,719	18,321	18,360	18,910	19,850	20,550	+2,831	+16.0
Nuclear	3,768	3,994	4,200	4,350	4,660	4,860	+1,092	+29.0
Hydro and geothermal	3,865	3,681	3,620	3,650	3,675	3,700	− 165	− 4.3